Robert J.A. Zito (RZ-6990)
Alan S. Lewis (AL-2828)
Karen E. Meara (KM-1944)
CARTER LEDYARD & MILBURN LLP
2 Wall Street
New York, New York 10005
(212) 732-3200

Attorneys for Defendant Christopher Finazzo

UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF NEW YORK

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UNITED STATES OF AMERICA,   :   Cr. No. 10-457 (RRM)

                                    :

                    v.   :

CHRISTOPHER FINAZZO,   :

            Defendant.   :

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MR. FINAZZO'S CORRECTED DISCLOSURE OF EXPERT SAM ROSENFARB, PURSUANT TO FED. R. CRIM. P. 16(B)(1)(C)

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Christopher Finazzo, through his attorneys Carter Ledyard & Milburn LLP, hereby provides the government and the Court with a summary of his expert witness' opinions, the bases and reasons for those opinions, and the witness' qualifications, pursuant to Fed. R. Crim. P. 16(b)(1)(c), and as a supplement to his previous expert witness disclosure, as follows:

I. WITNESS IDENTIFICATION, QUALIFICATIONS AND EXPERIENCE

Mr. Rosenfarb received his bachelor's degree in accounting from Queens College of the City University of New York. He is a certified public accountant (CPA), licensed in New York State since 1973. He is accredited in business valuation (ABV), and is a certified fraud examiner (CFE), a certified valuation analyst (CVA), and a certified business appraiser (CBA). Mr. Rosenfarb has testified numerous times in different courts. Since 1980 Mr. Rosenfarb has been engaged to provide expert trial testimony on a wide range of financial and accounting topics. Mr. Rosenfarb's resume and list of prior trial testimony is attached hereto as Exhibit 1.

II. SUMMARY OF OPINIONS

Based upon his business, financial and accounting experience, Mr. Rosenfarb is expected to testify on three topics: (1) the transactions between Aéropostale and South Bay were fair, bona fide, and a good deal for Aéropostale, (2) the quick replenishment system was a business improvement that enhanced the financial position of Aéropostale; and (3) the financial impact of Aéropostale's vendor matrix and relationships. The following summarizes Mr. Rosenfarb's opinions and the bases and reasoning for those opinions. Mr. Rosenfarb reserves the right to modify his opinions, if necessary, based on further review and analysis of information provided to him subsequent to the submission of this notice, including but not limited to, evidence adduced during the trial of this matter.

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III. **OPINION REGARDING THE TRANSACTIONS BETWEEN AÉROPOSTALE AND SOUTH BAY WERE FAIR, BONA FIDE AND A GOOD DEAL FOR AÉROPOSTALE**

Opinion:

The prices charged by South Bay to Aéropostale were reasonable under applicable circumstances and that, in connection with this matter, the transactions between South Bay and Aéropostale were fair, bona fide and a good deal for Aéropostale.

Basis and Reasons for Opinion:

In reaching his opinion that South Bay's prices were reasonable, Mr. Rosenfarb relied on the gross profit margins of South Bay, Aéropostale, and companies most comparable to South Bay. Because South Bay's profit margins were reasonable relative to Aéropostale and comparable companies, South Bay's prices were reasonable. "Gross profit represents the merchandising profit of a company. It is not a measure of the overall profitability of a company, because operating expenses have not been deducted … Comparisons of current gross profit with amounts reported in past periods, and comparisons of gross profit rates of competitors and with industry averages provide information about the effectiveness of a company's purchasing function and the soundness of its pricing policies."[1]

Mr. Rosenfarb calculated South Bay's gross profits using its Federal Income Tax Returns, Forms 1120S for the years 1998 through 2006. He then adjusted South Bay's gross profits to account for money paid to C&D Retail Consultants, Inc ("C&D") using C&D's Federal Income Tax Return, Forms 1120S for years 1998 through 2006 and Mr. Finazzo's Schedule E of his Federal Income Tax Return, Forms 1040 for years 1998 through 2006. Mr. Rosenfarb used the financial data contained in Aéropostale's public filings, specifically its forms 10-K filed on

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[1] Jerry J. Weygandt, Donald E. Kieso & Paul D. Kimmel, Accounting Principles (5th Ed. 1999) at 200, attached as Ex. 2.

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April 29, 2003, April 5, 2006, and April 2, 2007, and its form S-1 filed on March 8, 2002, which

contained Aéropostale's financial statements for fiscal years 1997 through 2006 to determine

Aéropostale's profit margin.

With respect to companies most comparable to South Bay, Mr. Rosenfarb obtained data

from the Risk Management Association's ("RMA") Annual Statement Studies. The information

in RMA's Annual Statement Studies is obtained from reports by individual companies to

banking institutions. In these studies, companies are not identified by name, but rather are

grouped by North American Industry Classification System ("NAICS") code. NAICS "is the

standard used by Federal statistical agencies in classifying business establishments for the

purpose of collecting, analyzing, and publishing statistical data related to the U.S. business

economy."[2] In his comparison with South Bay, Mr. Rosenfarb used nine NAICS codes for

companies most comparable to South Bay.

Mr. Rosenfarb found that the gross profits for the NAICS codes for businesses most

comparable to South Bay ranged from a low of 24.1% to a high of 36.3%, with an average of

31.6%.[3] South Bay's unadjusted gross profits were 13.37%, and its adjusted gross profits were

20.22%.

Mr. Rosenfarb compared the data he obtained from RMA with the gross profits for South

Bay and Aéropostale. The following is a chart summarizing his findings:

	Gross Profit %	Source
South Bay	13.37%	Income tax returns, from 1997 through 2006
South Bay, Adjusted	20.22%	Income tax returns, adjusted for amounts paid to C&D
Private Company Comparables – NAICS 323113	29.60%	RMA data

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[2] *See* http://www.census.gov/eos/www/naics.
[3] A table detailing the 2007 NAICS definition for each code is attached as Ex. 3.

Private Company Comparables – NAICS 315999	33.70%	RMA data
Private Company Comparables – NAICS 315211	28.10%	RMA data
Private Company Comparables – NAICS 315212	33.10%	RMA data
Private Company Comparables – NAICS 315222	24.10%	RMA data
Private Company Comparables – NAICS 315228	31.30%	RMA data
Private Company Comparables – NAICS 315233	34.30%	RMA data
Private Company Comparables – NAICS 315239	36.30%	RMA data
Private Company Comparables – NAICS 315299	33.90%	RMA data
Private Company Comparables Average	31.60%	RMA data
Aéropostale	27.65%	Financial statements, from fiscal year 1997 through 2006

Mr. Rosenfarb also relied on a report by Claris Consulting Group ("Claris"), Aéropostale's independent consultant, which endorsed the quick replenishment system using South Bay as the vendor.[4]

Mr. Rosenfarb's opinion regarding the financial fairness of the transactions between South Bay and Aéropostale is also based on a comparison of the financial data identified above. In reviewing this data, Mr. Rosenfarb found that South Bay's adjusted gross profits grew significantly more slowly than Aéropostale's gross profits, South Bay's adjusted gross profits were minor relative to Aéropostale's gross profits, South Bay's adjusted gross profit percentages were exceeded – often significantly – by Aéropostale's gross profit percentages each year after 1998, South Bay's operations were minor relative to Aéropostale's operations – with neither sales or adjusted gross profits exceeding 9% of Aéropostale's sales or gross profits,

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[4] *See* Claris Consulting Group, <u>Aéropostale: Graphic Tee Business Strategy Implementation</u> (May 6, 2004) ("Claris May Report).

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Aéropostale's CEO's compensation grew significantly from 2001 (approximately $770,000) through 2006 (approximately $6.4 million), and Aéropostale's sales grew significantly from 1997 (approximately $123.8 million) to 2006 (approximately $1.4 billion).[5]

Further supporting his opinion that South Bay's prices were reasonable, Mr. Rosenfarb also found that Aéropostale's gross profits forecast to be realized from sales of products purchased from South Bay (78.51%) were within 99% of the gross profits forecast to be realized from sales of products purchased from all vendors (79.14%).[6]

Mr. Rosenfarb's opinion is further based on Deloitte & Touche's certification of the financial statements of Aéropostale after its audit of Aéropostale's reported earnings and assets, as well as Aéropostale's systems of internal controls, which assure appropriate reporting of financial transactions.[7]

Thus, based on South Bay's reasonable prices, Claris' endorsement of the quick replenishment system using South Bay as the vendor, the financial fairness of the transactions, and Deloitte & Touche's certifications, there was no "lost opportunity" to Aéropostale.

IV.   OPINION REGARDING FINANCIAL IMPACT OF QUICK REPLENISHMENT

Opinion:

The "quick replenishment" manufacturing process employed by South Bay when supplying merchandise to Aéropostale, was a business improvement that enhanced the financial position or performance of Aéropostale relative to a system that was a less informing, less agile, less timely, and otherwise less preferred merchandise management practice.

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[5] Charts summarizing Mr. Rosenfarb's findings are attached as Ex. 4.

[6] *See* Select Finalization Analysis, attached as Ex. 5.

[7] *See, e.g.*, AEROPOSTALE: 10-K (filed Apr. 29, 2003) ("2003 10-K") at 27 (Independent Auditors' Report).

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Basis and Reasons for Opinion:

Quick replenishment improves the business of retailers such as Aéropostale because it enables them to respond quickly to market trends. Industry sources show that there are multiple methods of merchandise supply. There is the traditional method of supplying merchandise, which depends on relatively long periods required to supply, and relative product design inflexibility. There is a quick response system, which reduces periods required to supply, there is an enhanced design system, which provides greater product design flexibility, and there is a fast fashion system, which provides both a quick response and enhanced design capabilities.[8]

Mr. Rosenfarb is expected to testify that retailers, such as Aéropostale, improve their business from non-traditional methods of merchandise supply. Quick replenishment, for example, can positively impact quantity and sales by way of "geographic proximity and rapid supply chain response" which benefits retailers by permitting a retailer to "buy smaller quantities of colors and SKUs," and by resulting in "increased sales due to fewer stock-outs, ability to order smaller quantities, fewer markdowns and closeouts due to having less inventory or the wrong inventory, increased retail inventory turns and increased sales per square foot."[9]

In reaching his opinion, Mr. Rosenfarb relied on reports prepared by independent consultant Claris, which analyzed the benefits of Aéropostale implementing a quick replenishment system.[10] Claris found that for Aéropostale's graphic t-shirt business, "[d]ecreasing *replenishment order cycle time* is one of the keys to increasing gross margin. Reducing replenishment order cycle time allows stores to operate at reduced inventory levels

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[8] Gérard P. Cachon & Robert Swinney, The Value of Fast Fashion: Quick Response, Enhanced Design, and Strategic Consumer Behavior, 57 Management Science 778, 781-86 (Apr. 2011), attached as Ex. 6.
[9] Legwear Trends and Textiles of Tomorrow at 6 (Vol. 47, No. 08, Aug. 2006), *available at*: http://www.informinc.net/trends/lwpdf/lwtatt_aug06.pdf
[10] Claris Consulting Group, Aéropostale: Graphic Tee Business Strategy Implementation (Apr. 14, 2004); Claris May Report.

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which in turn reduces the number of mark downs. The relatively lengthy replenishment order cycle does not allow merchants to effectively re-order into selling. Often initial order and re-order quantities are increased to avoid lost sales resulting in higher inventory positions and increased mark downs." (emphasis in original).[11] The speed at which orders are fulfilled, however, "translates into higher costs."[12]

Mr. Rosenfarb also relied on Aéropostale's financial statements. In its financial statements, Aéropostale stated that it "employ[s] a sourcing strategy that maximizes [its] speed to market and allows [it] to respond quickly to [its] customers' preferences" and that "[t]he majority of [its] vendors can refill orders within 45 to 90 days, enabling quick inventory replenishment."[13] It further stated that one of its principal business strengths is its "[f]lexible operating structure that enables [it] to react quickly to changes in customer preferences"[14] which includes "strong and loyal relationships with [its] vendors which allow [it] to source and replenish [its] merchandise quickly."[15]

Mr. Rosenfarb is also expected to testify that South Bay's quick replenishment system enhanced the financial performance and position of Aéropostale during the period from 1996 to 2006, particularly due to the extremely rapid growth of the company. In reaching this conclusion, Mr. Rosenfarb relied on Aéropostale's Forms S-1 and 10-K for the years 1997 through 2007. As shown in the chart below, Aéropostale's sales increased more than 11 times (from $124 million to $1.4 billion), its gross profit percentages more than doubled (from 14% to 32%), and its liquidity (measured as its working capital, the excess of cash, inventory, and accounts receivable over current liabilities), divided by total assets, increased.

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[11] Claris May Report at 3.
[12] Caro & de Albéniz, The Impact of Quick Response, at 2.
[13] 2003 10-K at 4.
[14] AEROPOSTALE INC: S-1 (filed March 8, 2002) ("S-1") at 2.
[15] S-1 at 24.

	Fiscal Years Ended										
	Pre-Public					Post-Public					
	8/2/1997	8/1/1998	7/31/1999	7/29/2000	8/4/2001	2/2/2002	2/1/2003	1/31/2004	1/29/2005	1/28/2006	2/3/2007
Net Sales ($'000)	123,821	141,419	152,506	213,445	304,767	404,438	550,904	734,868	964,212	1,204,347	1,413,208
Gross Profit %	13.76%	20.99%	27.55%	28.80%	28.27%	32.4%	29.52%	31.26%	33.18%	30.10%	32.23%
Working Capital to Total Assets	32.38%	35.27%	37.40%	8.75%	8.92%	25.99%	38.91%	45.88%	44.97%	42.26%	40.26%

Mr. Rosenfarb is also expected to testify that while quick response merchandise costs are estimated by some "to be 15 to 20% higher than traditional firms producing in Asia,"[16] quick response systems "yield significant value to firms by better matching supply and demand."[17] Such value is achieved by "reducing [sales lost due to slow replenishment] when quick response is implemented" and by a "behavioral effect ... [of] the increase in the selling price when quick response is implemented because consumers anticipate a lower probability of a sale (so they are willing to pay a higher initial price)."[18]

V. OPINION REGARDING THE FINANCIAL IMPACT OF AÉROPOSTALE'S VENDOR MATRIX AND VENDOR SELECTION

Opinion:

Vendor selection, vendor limitation and vendor relationships impact the finances of Aéropostale as well as its vendors.

Basis and Reasons for Opinion:

Mr. Rosenfarb's opinion is based on his experience and review of Aéropostale's financial statements, in which Aéropostale has asserted that it implemented multiple controls to ensure the oversight of vendors and quality of product. Specifically, Aéropostale stated that it "reduce[d] the number of vendors that [it] utilize[s] in order to streamline [its] sourcing operations and to

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[16] Caro & de Albéniz, The Impact of Quick Response, at 30.
[17] Cachon & Swinney, The Value of Fast Fashion, at 778.
[18] Cachon & Swinney, The Value of Fast Fashion, at 784

exercise greater influence over [its] vendors."[19]   Aéropostale further stated that it ensured "the

quality of [its] vendors' products by inspecting pre-production samples, making periodic site

visits to [its] vendors' foreign production factories and by selectively inspecting inbound

shipments at [its] distribution center."[20]   Aéropostale commented that its "[c]hanges in systems

and techniques" (referring to quick replenishment) had a favorable impact on its gross profit and

inventory impact because the quick replenishment system allowed it to maximize gross margin

and be "less promotional" because its inventories were "right where [they] want[ed] them."[21]

Aéropostale also stated in 2003 that as a result of its "inventory control, [it] continues to

see faster rates." Furthermore, "[o]n a trailing four-quarter basis, Aéropostale's inventory turns

reached a record 7.0 turns per year versus 6.75 last [quarter]," and that the initiative it had "with

graphic T-shirts for the last year and a half of replenishing by size, by color, by screen, by store

in 72 hours clearly gives [it] the ability to run with less inventory."[22]

Mr. Rosenfarb's experience has shown him that in regards to profit expectations, the

vendor should expect to compete for a vendee's business – and vice versa if the vendee requires

products or a vendor process is unique enough to create scarce supply. Price concession

forfeited by a vendor or price premiums do not always indicate a diminution of a vendor

relationship, and could exist to support an on-going, long-term relationship. A significant

vendor's willingness to extend favorable credit terms could similarly be a material component of

vendor relationship value. Here, Aéropostale's CFO testified at trial that South Bay was its only

vendor to have the quick replenishment system, indicating that South Bay's process was unique.

In addition, Aéropostale's General Counsel testified that South Bay was an early vendor of

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[19] 2003 10-K at 4.
[20] 2003 10-K at 4.
[21] Q2 2003 Aeropostale, Inc. Earnings Conference Call (Aug. 21, 2003).
[22] Q2 2003 Aeropostale, Inc. Earnings Conference Call (Aug. 21, 2003).

Aéropostale and extended credit terms during this early period during which Aéropostale needed credit terms and continued to extend such credit terms throughout the relationship and that Aéropostale rewarded such early relationships with continued vendor loyalty.

Mr. Rosenfarb also relied on his experience in assessing, valuing, and investigating many businesses and their relationships with their stakeholders – customers, vendors, employees, equity and bond holders to evaluate Aéropostale's vendor system and its relationship with South Bay. Successful vendor relationships result from vendor delivered value. Value consists of business profits expected to be realized by both vendor and vendee. Benefits will inure to each party by setting and managing each other's product, process, and profit expectations – a result only achieved with effective and fair communications.

Dated: New York, NY
      April 12, 2013

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CARTER LEDYARD & MILBURN LLP

By: _____
Robert J.A. Zito
2 Wall Street
New York, NY 10005
Tel.: (212) 732-3200

Attorneys for Defendant Christopher Finazzo

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EXHIBIT 1

ROSENFARB
Forensic Accounting and Valuation Experts

CURRICULUM VITAE

Sam Rosenfarb

sam@rosenfarb.com
(855) 415-1500

CERTIFICATIONS
Certified Public Accountant
(CPA), licensed in New York
State
Accredited in Business
Valuation
(ABV)
Certified Fraud Examiner (CFE)
Certified Valuation Analyst
(CVA)
Certified Business Appraiser
(CBA)

EDUCATION
B.A., Accounting, Queens
College of the City University of
New York

SUMMARY

As Managing Director of the Firm, Sam Rosenfarb originates, supervises and reviews client engagements in the areas of financial consulting, investigations, valuations and expert witness services. With more than 40 years of experience, including Partner-in-Charge of the forensic accounting practice at a large CPA firm, Mr. Rosenfarb is a proven and demonstrated leader. Mr. Rosenfarb's forensic accounting skills arise from his significant experience in the investigation of fraud, financial damages and business crimes.

Mr. Rosenfarb is frequently engaged by clients to provide deposition and trial testimony. Throughout his career, he has testified as an expert witness in numerous matters including damage calculations, matrimonial litigation, accounting malpractice, estate issues, partnership disputes, business valuations and insolvencies. Mr. Rosenfarb has served as a court appointed expert and arbitrator, including appointment to the Panel of Arbitrators by the American Arbitration Association.

Mr. Rosenfarb is a recognized industry expert and has presented seminars and continuing legal education courses on various topics including valuation techniques, mergers and acquisitions, valuation aspects of divorce, forensic accounting and alternative dispute resolutions. In addition, he has hosted the cable television programs "White Collar Crime Report" and "It's All About Money."

PROFESSIONAL AND CIVIC AFFILIATIONS
American Institute of Certified Public Accountants (AICPA)
New Jersey Society of Certified Public Accountants (NJSCPA),
- Past Vice President & Trustee
- Litigation Services Committee, Chair
- Alternative Dispute Resolution Committee, Chair
New York State Society of Certified Public Accountants (NYSSCPA)
Association of Certified Fraud Examiners
Institute of Business Appraisers
National Association of Certified Valuation Analysts

TRIAL TESTIMONY OF SAM ROSENFARB

DATE	JUDGE	ON BEHALF OF	IN THE MATTER OF	ATTORNEY	LAW FIRM	COURT	TOPIC
(illegible)	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*
2011	Bennett	Respondent	Metzger, Inc. v. FujiFilm et al.	Vincent N. Avallone	K&L Gates, LLP	Arbitration New York, NY	Breach of Contract
(illegible)	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*
2011	Hellerstein	Defendant	Deep Woods Holdings v. SDIF of Turkey	John A. Basinger	Baker & McKenzie, LLP	Federal District Court New York, NY	Bank Valuation
(illegible)	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*
2010	Panel	Counter Claimants	1818 Mezzanine Fund v. Glenn Edwards and Scott R. Mixer	R. Scott Thompson	Lowenstein Sandler, P.C.	Arbitration New York, NY	Breach of Reps & Warranties
(illegible)	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*
2009	Contillo	Defendants	Perelman as Executor v. Booth Computers and James Cohen	Frank Huttle	DeCotiis, FitzPatrick & Cole, LLP	Superior Court Bergen County NJ	Real Estate Partnership

TRIAL TESTIMONY OF SAM ROSENFARB

DATE	JUDGE	ON BEHALF OF	IN THE MATTER OF	ATTORNEY	LAW FIRM	COURT	TOPIC
2009							Real Estate Malpractice
2008	Baer	Defendant	Cerveceria Modelo, S.A. v. USPA Accessories LLC	Ira Tokayer	Law Offices of Ira Tokayer	Federal District Court New York, NY	Trademark Infringement
2008							Tax Fraud
2008	Gerges	Plaintiff	Ray Realty, Inc. v. Kwang Hee Lee	Edward G. McCabe	Certilman Balin Adler & Hyman, LLP	Supreme Court Kings County NY	Lost Profits
							Business Valuation
2007	Panel	Respondent	Convergia Networks, Inc. v. Huawei Technologies Co. Ltd et al.	Jay Alexander	Baker Botts, LLP	International Arbitration New York, NY	Contract Damages
							Gain/Loss
2006	Brown	Plaintiff	U.S Trust Corporation v. Jamison et al.	Lawrence Carnevale	Carter Ledyard & Milburn, LLP	Federal District Court Trenton, NJ	Lost Profits

TRIAL TESTIMONY OF SAM ROSENFARB

DATE	JUDGE	ON BEHALF OF	IN THE MATTER OF	ATTORNEY	LAW FIRM	COURT	TOPIC
(illegible)	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*
2005	Bissell	Defendant	Charles Lomack, et al. v. City of Newark, et al.	Carolyn McIntosh	City of Newark Corporate Counsel	Federal District Court Newark, NJ	Compliance with Consent Decree
(illegible)	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*
2004	Schmidt	Plaintiff	Ray Realty Fulton, Inc. v. Kwang Hee Lee	Edward G. McCabe	Certilman Balin Adler & Hyman, LLP	Supreme Court Kings County NY	Fraudulent Conveyance
(illegible)	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*
2002	JCMUA Commission	Plaintiff	Cali Harborside Associates v. Jersey City Municipal Util. Auth.	Richard L. Rudin	Weiner Lesniak, LLP	Jersey City Utilities Authority	Rate Calculation
(illegible)	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*
2001	Michels	Plaintiff	Samuel Weinstock v. Herman Weinstock	Tab Rosenfeld	Rosenfeld & Kaplan, LLP	Arbitration Essex County NJ	Business Valuation

TRIAL TESTIMONY OF SAM ROSENFARB

DATE	JUDGE	ON BEHALF OF	IN THE MATTER OF	ATTORNEY	LAW FIRM	COURT	TOPIC
(illegible)	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*
2001	Tribunal	Respondent	US Manufacturer v. Japanese Trading Company	William. Sondericker	Carter Ledyard & Milburn, LLP	Arbitration New York, NY	Breach of Contract Damages
(illegible)	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*
1999	Wilson	Plaintiff	Hansen v. Hansen	Gary Newman	Newman, McDonough, Schofel & Giger, P.C.	Superior Court Morris County NJ	Business Valuation
(illegible)	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*
1998	Schaeffer	Defendant	Robert Starbuck v. Jacqueline Munro	John N. Post	Post Polak Goodsell MacNeill & Strauchler, P.A.	Superior Court of NJ, Morris County	Accounting Theory
(illegible)	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*
1998	Rigler	Defendant	Sharon Steinberger v. Chaim T. Steinberger	Chaim T. Steinberger	Chaim Steinberger, P.C.	Supreme Court Kings County NY	Enhanced Earnings

TRIAL TESTIMONY OF SAM ROSENFARB

DATE	JUDGE	ON BEHALF OF	IN THE MATTER OF	ATTORNEY	LAW FIRM	COURT	TOPIC
(illegible)	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	Business Valuation *(illegible)*
1998	Winard	Defendant	Dear v. Garden State Indemnity Corp.	Lewis B. Cohn	Witman Stadtmauer, P.A.	Superior Court Essex County NJ	Accounting Malpractice
1995 *(illegible)*	Roenbu *(illegible)*	Defendant	*(illegible)*	Lewis B. Cohn *(illegible)*	Witman Stadtmauer *(illegible)*	Superior Court Essex County NY *(illegible)*	Accounting Malpractice *(illegible)*
1996	Barry	Plaintiff	Cooper Distributing Co., Inc. v. Amana Refrigeration	S. M. Chris Franzblau	Franzblau & Dratch, P.C.	Federal District Court Newark, NJ	Breach of Franchise Agreement
(illegible)	Friedman *(illegible)*	Chairman *(illegible)*	*(illegible)*	*(illegible)*	Phillips Nizer *(illegible)*	New York, NY *(illegible)*	Breach of Franchise Damages *(illegible)*
1994	Bassler	Plaintiff	Florida Video System v. Sony Corp. of America	Richard S. Taffet	Bingham McCutchen, LLP	Federal District Court Newark, NJ	Breach of Contract Damages & Business Valuation
(illegible)	Gauable *(illegible)*	Doctor *(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	Newark, NJ *(illegible)*	Business Valuation *(illegible)*
1994	Convery	Defendant	Reese v. Reese	Peter C. Vitanzo	Law Office of Peter C. Vitanzo	Superior Court Essex County NJ	Business Valuation

TRIAL TESTIMONY OF SAM ROSENFARB

DATE	JUDGE	ON BEHALF OF	IN THE MATTER OF	ATTORNEY	LAW FIRM	COURT	TOPIC
1988	Hopkins	Plaintiff	Buford v. Ernst	Donald Feldman	Law Offices of Donald Feldman	Superior Court Stanislaus County, CA	Trial of Testimony Damages
1991	Rigler	Defendant	Rae Rosen v. Mark Rosen	Vivienne Garfinkle	Law Office of Vivienne Garfinkle	Supreme Court Kings County NY	Enhanced Earnings
1992	Feeney	Plaintiff	Devine v. Farwell / Patureau Hanwell	Vivienne Garfinkle	Law Office of Vivienne Garfinkle	Supreme Court Westchester County NY	Enhanced Earnings / Business Valuation

DEPOSITION TESTIMONY OF SAM ROSENFARB

DATE	ON BEHALF OF	IN THE MATTER OF	ATTORNEY	LAW FIRM	TOPIC
2011	Respondent	Metzger, Inc. v. FujiFilm et al.	Vincent N. Avallone	K&L Gates, LLP	Breach of Contract
(illegible)	Plaintiff	RGI... v. Wachovia Bank	Marin Kaminsky	Buzzell...	Regulatory Dispute
2010	Defendant	Deep Woods Holdings v. SDIF of Turkey	John A. Basinger	Baker & McKenzie, LLP	Bank Valuation
2010	Plaintiff	...Corp. v. Dell Computer Corp.	Edward... Mann	Bingham McCutchen, LLP	Trademark Infringement
2010	Defendant	Port Authority v. Pittston Warehouse Corp.	Lewis Cohn	Witman Stadtmauer, P.A.	Breach of Lease
(illegible)	Defendant	...Tapestry	Stephen M. Shamah	Witman Stadtmauer...	...Contract dispute
2009	Respondent	Battery Park City Authority v. WFP Tower A Co. L.P.	Jeremy Wallison	Foley & Lardner, LLP	Accounting Dispute
(illegible)	Plaintiff	...	...	...	Breach of Contract...
2008	Defendant	Gershaw v. Stuart Carlitz and Therapedic Sleep Products, Inc.	Laurence B. Orloff	Orloff, Lowenbach, Stifelman & Siegel, P.A.	Breach of Shareholders' Agreement
(illegible)	Plaintiff	...	...	...	Partnership Agreement Violation

DEPOSITION TESTIMONY OF SAM ROSENFARB

DATE	ON BEHALF OF	IN THE MATTER OF	ATTORNEY	LAW FIRM	TOPIC
2007	Plaintiff	GFI Brokers, LLC v. John Santana	Lawrence Carnevale	Carter Ledyard & Milburn, LLP	Liquidated Damages
2007	Defendant	*(illegible)*	*(illegible)*	Baker Botts LLP	Economic Damages
2007	Defendant	Paul Marcus v. Lincolnshire Management, Inc.	Gregory T. Heyman	Kirkland & Ellis LLP	Business Valuation
2006	Defendant	Stanley Connolly... *(illegible)*	*(illegible)*	*(illegible)*	Damages from Stop Employee Relat... *(illegible)*
2006	Plaintiff	Dicar, Inc. et al. v. Alan D. Kirkpatrick, Jr. et al.	David L. Harris	Lowenstein Sandler, P.C.	Intangible Asset Valuation
2005	Plaintiff	U.S. Mineral Products... *(illegible)*	*(illegible)*	*(illegible)*	Patent System Legal Valuation
2006	Plaintiff	U.S Trust Corporation v. Jamison et al.	Lawrence Carnevale	Carter Ledyard & Milburn, LLP	Lost Profits
2005	Plaintiff	...Manufacturing Supply Products Company *(illegible)*	William R. Wallace *(illegible)*	*(illegible)*	Breach of Supply Contract
2005	Plaintiff	Vance Wilson v. Daffy's, Inc. et al.	Roger B. Kaplan	Greenberg Traurig, LLP	Projected Operations
2005	Plaintiff	Merrill Lynch et al. v. American Reprographics *(illegible)*	*(illegible)*	*(illegible)*	Intangible Business Value

DEPOSITION TESTIMONY OF SAM ROSENFARB

DATE	ON BEHALF OF	IN THE MATTER OF	ATTORNEY	LAW FIRM	TOPIC
2005	Defendant	Charles Lomack, et al. v. City of Newark, et al.	Carolyn McIntosh	City of Newark Corporate Counsel	Compliance with Consent Decree
(illegible)	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*
2003	Defendant	Gregory F. Sullivan, M.D. v. McCarter & English	Laurence B. Orloff	Orloff, Lowenbach, Stifelman & Siegel, P.A.	Damages from Legal Malpractice
(illegible)	Plaintiff	*(illegible)*	*(illegible)*	*(illegible)*	Damages from Legal Malpractice *(illegible)*
2003	Defendant	Amerace Corp. v. Aetna Casualty & Surety Company, et al.	Dennis Monaghan	Graham Curtin, P.A.	Pre-judgment Interest
(illegible)	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*
2001	Defendant	Carroll v. Estate of Ross Weiss	Keith Burns	Burns & Associates	Fiduciary Accounting
(illegible)	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*
1999	Defendant	Shui v. Zipf	Frank Lloyd	Harwood Lloyd, LLC	Wrongful Termination Damages
(illegible)	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*	*(illegible)*

DEPOSITION TESTIMONY OF SAM ROSENFARB

DATE	ON BEHALF OF	IN THE MATTER OF	ATTORNEY	LAW FIRM	TOPIC
1998	Defendant	Picinich v. Hizza	Dolph Corradino	Law Office of Dolph Corradino	Accounting Malpractice
1997	Plaintiff	Haselkom v. Haselkom	Edward Snyder	Wolff & Samson P.C.	Business Valuation
1995	Defendant	Dumar v. Bond and Andiola	Leonard Rosenstein	Hurley, Vasios, Kelly & Strollo, P.A.	Accounting Malpractice

EXHIBIT 2

Accounting Principles

Fifth Edition
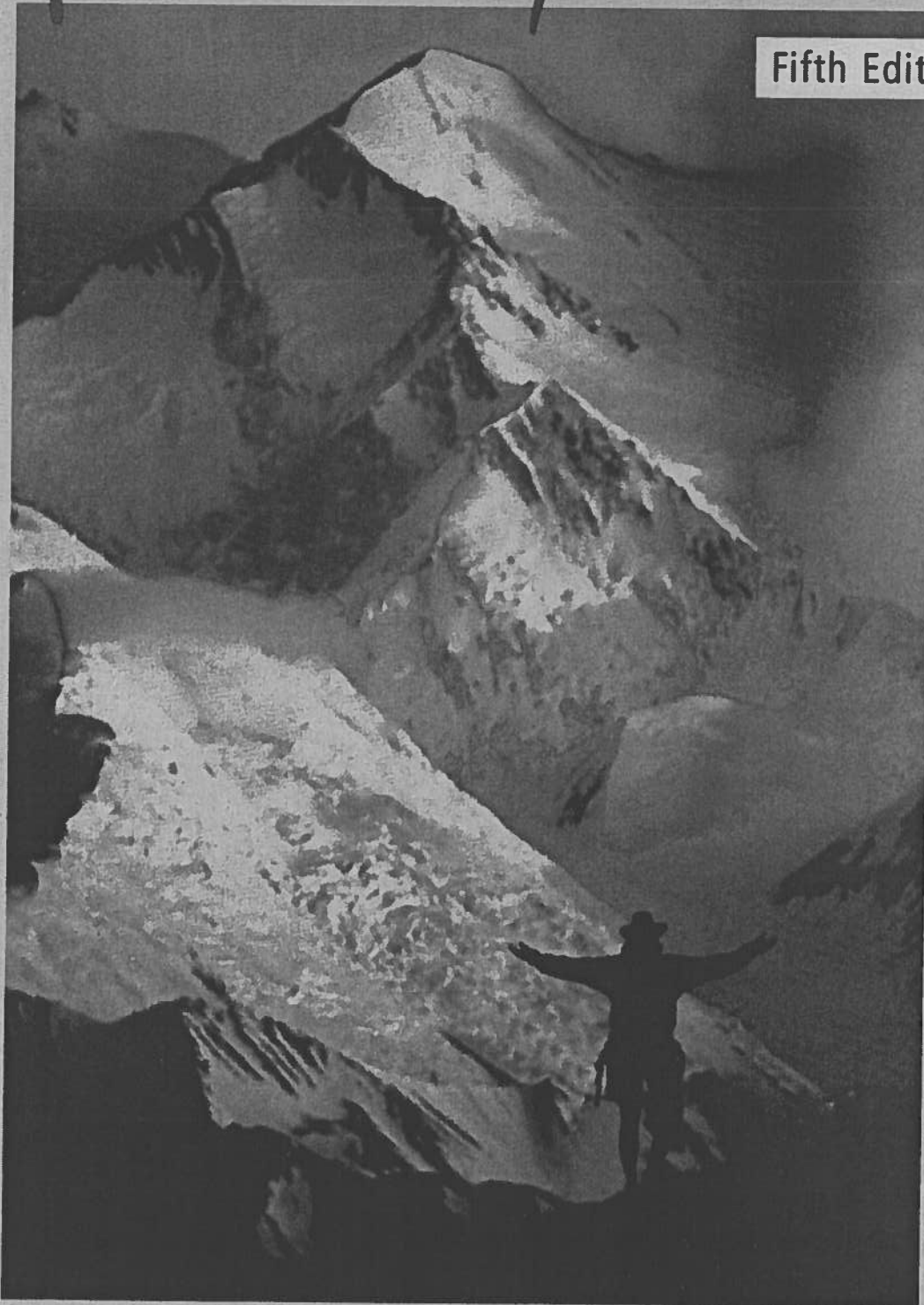
WEYGANDT / KIESO / KIMMEL

ACCOUNTING PRINCIPLES

5th Edition

JERRY J. WEYGANDT   Ph.D., CPA
Arthur Andersen Alumni Professor of Accounting
University of Wisconsin
Madison, Wisconsin

DONALD E. KIESO   Ph.D., CPA
KPMG Peat Marwick Emeritus Professor of Accountancy
Northern Illinois University
DeKalb, Illinois

PAUL D. KIMMEL   Ph.D., CPA
Associate Professor of Accounting
University of Wisconsin—Milwaukee
Milwaukee, Wisconsin

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200   Chapter 5 • Accounting for Merchandising Operations

ALTERNATIVE TERMINOLOGY
Gross profit is sometimes referred to as *merchandising profit* or *gross margin*.

A company's gross profit may also be expressed as a percentage by dividing the amount of gross profit by net sales. For Highpoint Electronic the gross profit rate is 31.3% ($144,000 ÷ $460,000). The gross profit rate is generally considered to be more useful than the gross profit amount because it expresses a more meaningful (qualitative) relationship between net sales and gross profit. For example, a gross profit of $1,000,000 may be impressive. But, if it is the result of a gross profit rate of only 7%, it is not so impressive. The gross profit rate tells how many cents of each sales dollar go to gross profit.

Gross profit represents the **merchandising profit** of a company. It is not a measure of the overall profitability of a company, because operating expenses have not been deducted. Nevertheless, the amount and trend of gross profit is closely watched by management and other interested parties. Comparisons of current gross profit with amounts reported in past periods, and comparisons of gross profit rates of competitors and with industry averages provide information about the effectiveness of a company's purchasing function and the soundness of its pricing policies.

ACCOUNTING IN ACTION
Business Insight

In a recent year, J.C. Penney Company reported a gross profit rate of 31%; Kmart, 24%; and Wal-Mart, 20%. Gross profit is critical. "If you don't have someone monitoring it," says one business consultant, "you are asking for instant death." A decline should trigger a search for the cause. The drop could be due to an increase in cost of goods sold or a decrease in sales revenue, either of which needs prompt attention. The change may be temporary and easily reversed, or it may signal the beginning of a bad trend.

Operating Expenses

Operating expenses are the third component in measuring net income for a merchandising company. As indicated earlier, these expenses are similar in merchandising and service enterprises. At Highpoint Electronic, operating expenses were $114,000. The firm's net income is determined by subtracting operating expenses from gross profit. Thus, net income is $30,000 as shown below:

ILLUSTRATION 5-9

Operating expenses in computing net income

Gross profit	$144,000
Operating expenses	114,000
Net income	$ 30,000

The net income amount is the "bottom line" of a company's income statement.

5
STUDY OBJECTIVE
....
Identify the features of the income statement for a merchandising company.

Income Statement

The income statement for retailers and wholesalers contains three features not found in the income statement of a service enterprise. These features are: (1) a sales revenue section, (2) a cost of goods sold section, and (3) gross profit. Using assumed data for specific operating expenses, the income statement for Highpoint Electronic, is shown in Illustration 5-10.

EXHIBIT 3

United States of America v. Christopher Finazzo and Douglas Dey
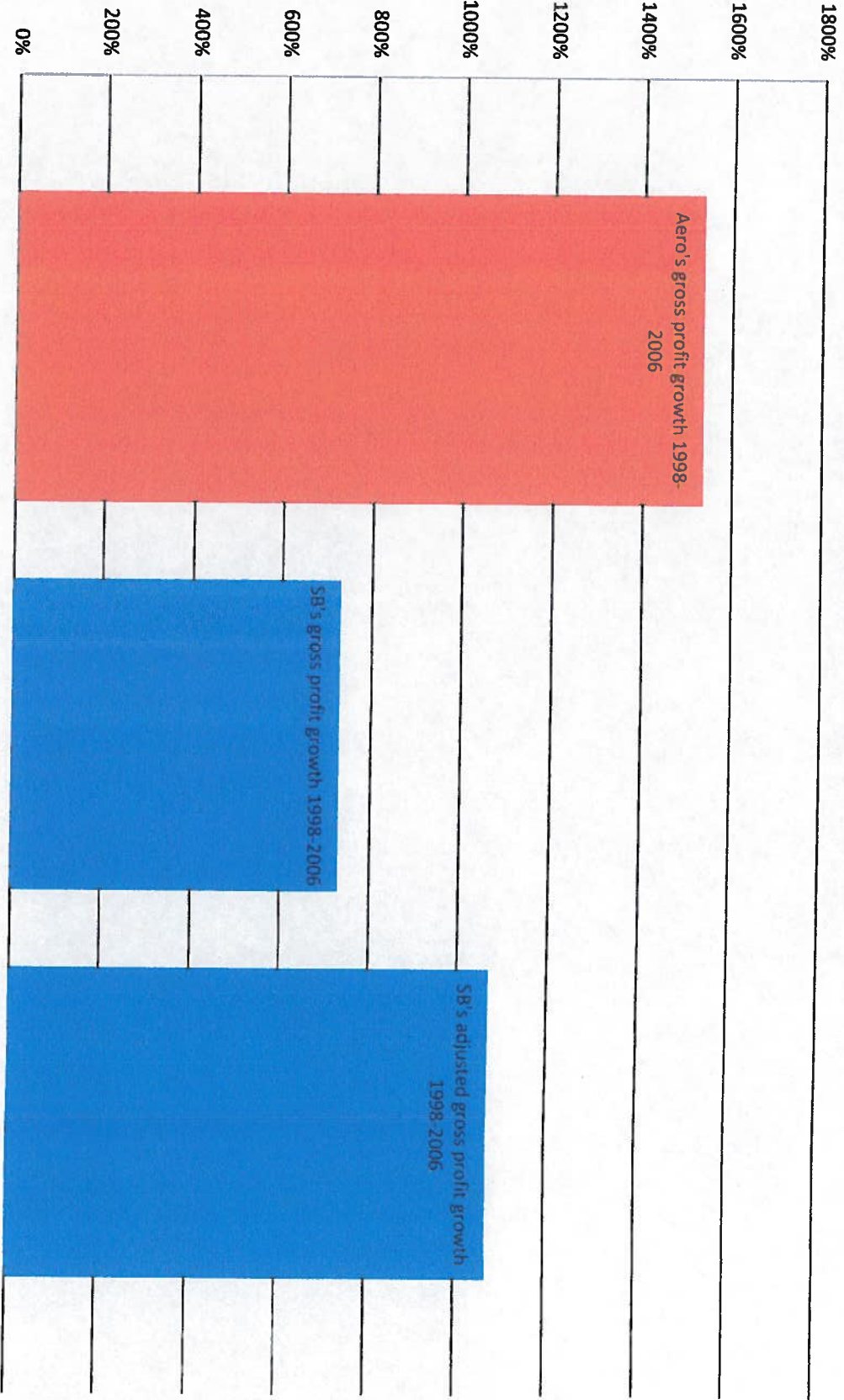Gross Profit % for Private Companies
Selected NAICS Codes

NAICS Code (RMA) [1]	Industry (RMA)	2007 NAICS Code (Online)	2007 NAICS Definition	Gross Profit % [2]
323113	Manufacturing-Commercial Screen Printing	323113	This U.S. industry comprises establishments primarily engaged in screen printing without publishing (except books, grey goods, and manifold business forms). This industry includes establishments engaged in screen printing on purchased stock materials, such as stationery, invitations, labels, and similar items, on a job order basis. Establishments primarily engaged in printing on apparel and textile products, such as T-shirts, caps, jackets, towels, and napkins, are included in this industry.	29.6%
315999	Manufacturing-Other Apparel Accessories and Other Apparel Manufacturing	315999	This U.S. industry comprises establishments primarily engaged in manufacturing apparel and apparel accessories (except apparel knitting mills; cut and sew apparel contractors; cut and sew apparel; hats and caps; mittens and gloves; and mens and boys' neckwear). Jobbers for these products, who perform entrepreneurial functions involved in other apparel and accessory manufacture, including buying raw materials, designing and preparing samples, arranging for other apparel and accessories to be made from their materials, and marketing finished other apparel and accessories, are included. Examples of products made by these establishments are apparel trimmings and findings; belts, women's scarves, and suspenders.	33.7%
315211	Manufacturing-Men's and Boy's Cut and Sew Apparel Contractors	315211	This U.S. industry comprises establishments commonly referred to as contractors primarily engaged in (1) cutting materials owned by others for mens and boys' apparel and/or (2) sewing materials owned by others for men's and boys apparel.	28.1%
315212	Manufacturing-Women's, Girls', and Infants' Cut and Sew Apparel Contractors	315212	This U.S. industry comprises establishments commonly referred to as contractors primarily engaged in (1) cutting materials owned by others for women's, girls', and infants' apparel and accessories and/or (2) sewing materials owned by others for women's, girls', and infants' apparel and accessories.	33.1%
315222	Manufacturing-Men's and Boy's Cut and Sew, Suit, Coat and Overcoat Manufacturing	315222	This U.S. industry comprises establishments primarily engaged in manufacturing mens and boys' suits, overcoats, sport coats, tuxedos, dress uniforms, and other tailored apparel (except fur and leather) from purchased fabric. Men's and boys suit, coat, and overcoat jobbers, who perform entrepreneurial functions involved in apparel manufacture, including buying raw materials, designing and preparing samples, arranging for apparel to be made from their materials, and marketing finished apparel, are included.	24.1%
315228	Manufacturing-Men's and Boy's Cut and Sew Other Outerwear Manufacturing	315228	This U.S. industry comprises establishments primarily engaged in manufacturing mens and boys' cut and sew outerwear from purchased fabric (except underwear, nightwear, shirts, suits, overcoats and tailored coats, separate trousers and slacks, and work clothing). Men's and boys' other outerwear jobbers, who perform entrepreneurial functions involved in apparel manufacture, including buying raw materials, designing and preparing samples, arranging for apparel to be made from their materials, and marketing finished apparel, are included. Unisex sweatpants and similar garments that are sized without specific reference to gender (i.e., adult S, M, L, XL) are also included in this industry. Examples of products made by these establishments are athletic clothing (except athletic uniforms), bathing suits, down coats, outerwear shorts, windbreakers and jackets, and jogging suits.	31.3%
315233	Manufacturing-Women's, Girls' Cut and Sew Dress Manufacturing	315233	This U.S. industry comprises establishments primarily engaged in manufacturing womens and girls' dresses from purchased fabric. Women's and girls' dress jobbers, who perform entrepreneurial functions involved in apparel manufacture, including buying raw materials, designing and preparing samples, arranging for apparel to be made from their materials, and marketing finished apparel, are included.	34.3%
315239	Manufacturing-Women's, Girls' Cut and Sew Other Outerwear Manufacturing	315239	This U.S. industry comprises establishments primarily engaged in manufacturing womens and girls' cut and sew apparel from purchased fabric (except underwear, lingerie, nightwear, blouses, shirts, dresses, suits, tailored coats, and skirts). Women's and girls' other outerwear clothing jobbers, who perform entrepreneurial functions involved in apparel manufacture, including buying raw materials, designing and preparing samples, arranging for apparel to be made from their materials, and marketing finished apparel, are included. Examples of products made by these establishments are bathing suits, down coats, sweaters, jogging suits, outerwear pants and shorts, and windbreakers.	36.3%
315299	Manufacturing-All Other Cut and Sew Apparel manufacturing	315299	This U.S. industry comprises establishments primarily engaged in manufacturing cut and sew apparel from purchased fabric (except cut and sew apparel contractors; mens and boys' cut and sew underwear, nightwear, suits, coats, shirts, trousers, work clothing, and other outerwear; women's and girls' lingerie, blouses, shirts, dresses, suits, coats, and other outerwear; infants' apparel; and fur and leather apparel). Clothing jobbers for these products, who perform entrepreneurial functions involved in apparel manufacture, including buying raw materials, designing and preparing samples, arranging for apparel to be made from their materials, and marketing finished apparel, are included. Examples of products made by these establishments are team athletic uniforms; band uniforms, academic caps and gowns, clerical vestments, and costumes.	33.9%
Average				31.6%

Note 1: [1] Reflects the North American Industry Classification System ("NAICS") Codes.
Note 2: [1] Reflects data from RMA's 2012 Annual Statement Studies for businesses with sales greater than $25 million for NAICS codes indicated above, using RMA's data from April 2011 through March 2012.

EXHIBIT 4

United States of America v. Christopher Finazzo and Douglas Dey
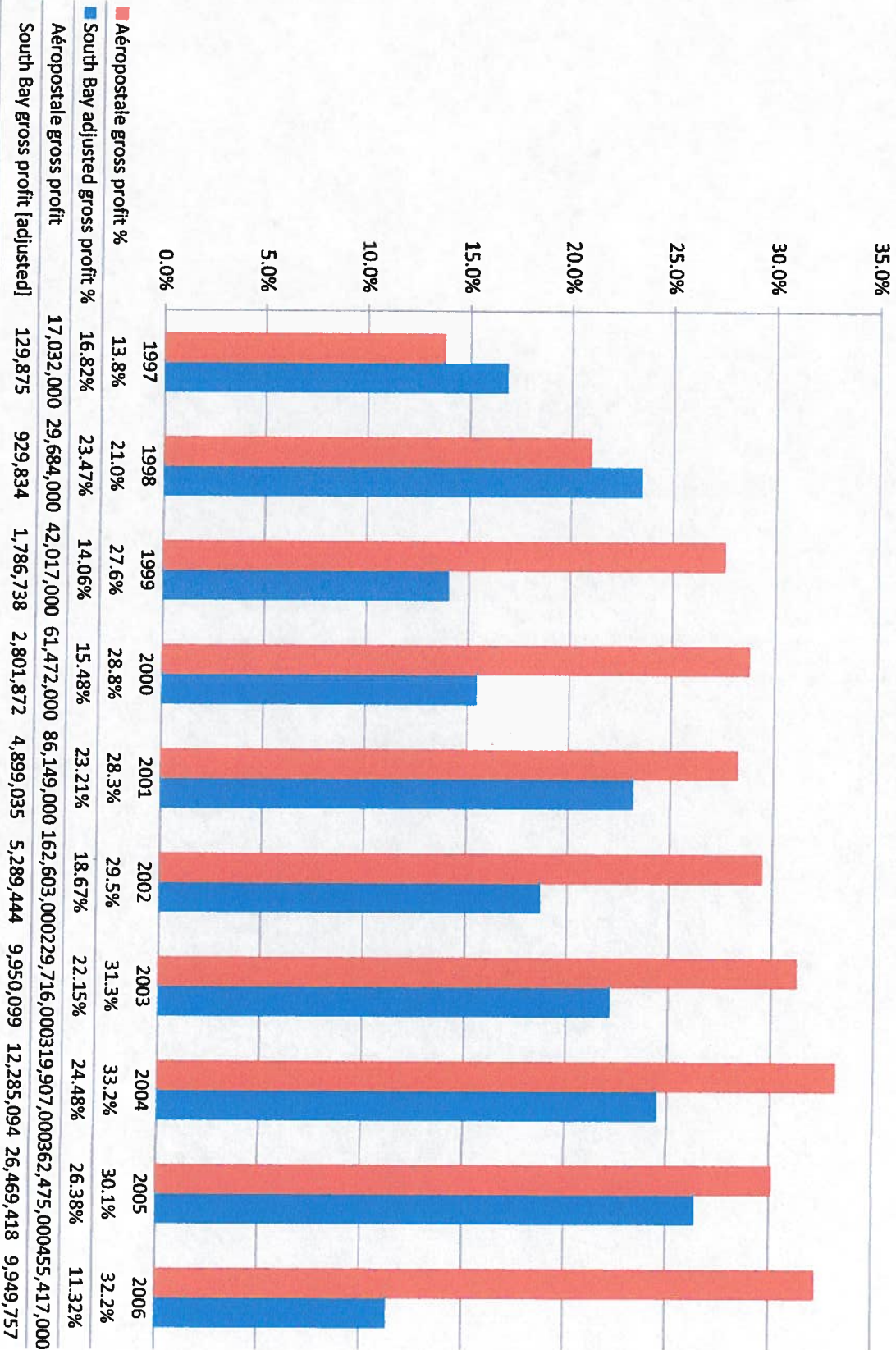## Gross Profit Growth Comparison

Bar chart showing:
- Aero's gross profit growth 1998-2006
- SB's gross profit growth 1998-2006
- SB's adjusted gross profit growth 1998-2006

X-axis: 0%, 200%, 400%, 600%, 800%, 1000%, 1200%, 1400%, 1600%, 1800%

United States of America v. Christopher Finazzo and Douglas Dey

Gross Profit Comparison

Legend:
- Aéropostale gross profit
- South Bay gross profit [adjusted]

Year	South Bay gross profit [adjusted]	Aéropostale gross profit
1997	129,875	17,032,000
1998	929,834	29,684,000
1999	1,786,738	42,017,000
2000	2,801,872	61,472,000
2001	4,899,035	86,149,000
2002	5,289,444	162,603,000
2003	9,950,099	229,716,000
2004	12,285,094	319,907,000
2005	26,469,418	362,475,000
2006	9,949,757	455,417,000

Axis values: 50,000,000 / 100,000,000 / 150,000,000 / 200,000,000 / 250,000,000 / 300,000,000 / 350,000,000 / 400,000,000 / 450,000,000 / 500,000,000

United States of America v. Christopher Finazzo and Douglas Dey

Gross Profit % Comparison

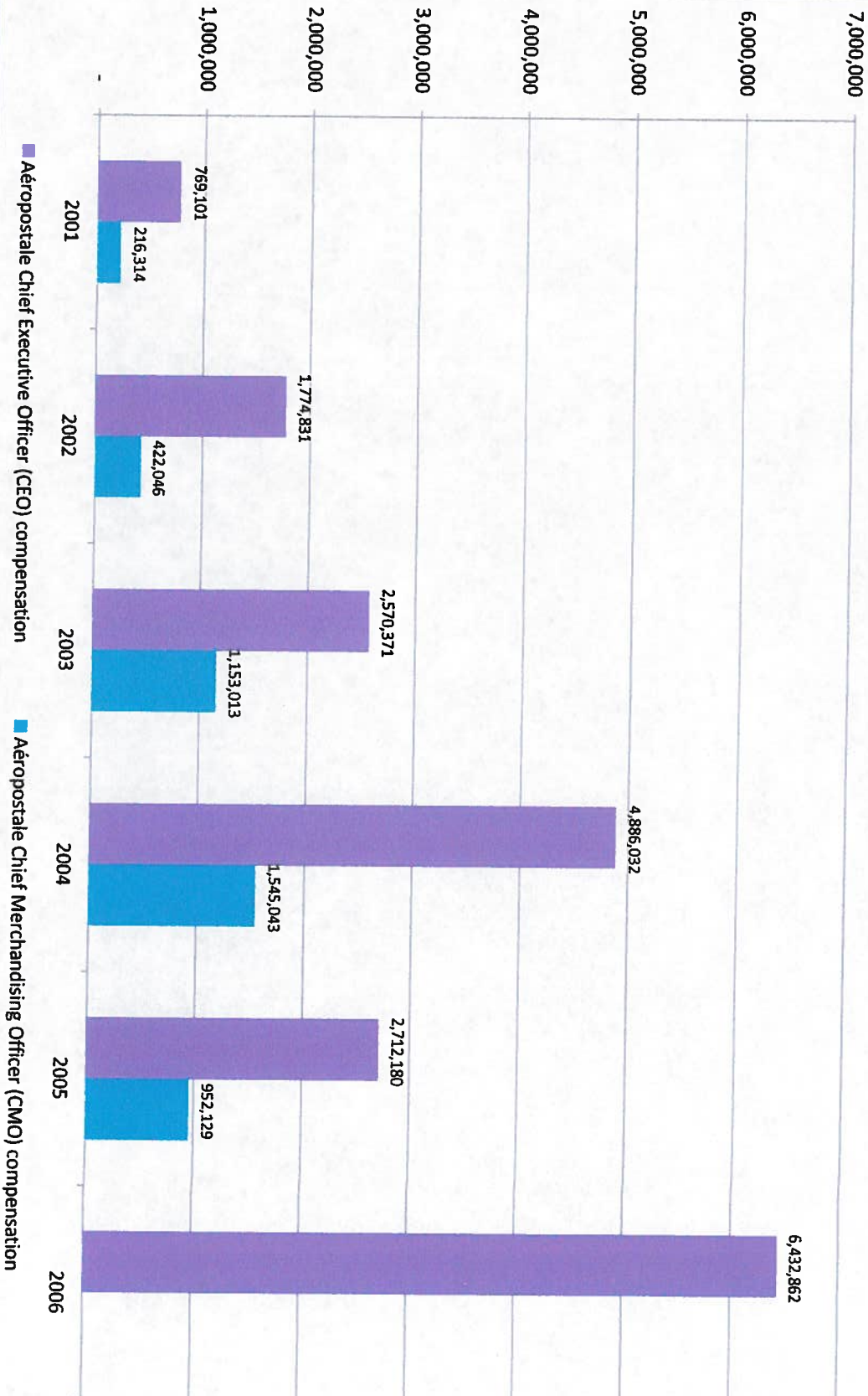|	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Aéropostale gross profit %	13.8%	21.0%	27.6%	28.8%	28.3%	29.5%	31.3%	33.2%	30.1%	32.2%
South Bay adjusted gross profit %	16.82%	23.47%	14.06%	15.48%	23.21%	18.67%	22.15%	24.48%	26.38%	11.32%
Aéropostale gross profit	17,032,000	29,684,000	42,017,000	61,472,000	86,149,000	162,603,000	229,716,000	319,907,000	362,475,000	455,417,000
South Bay gross profit [adjusted]	129,875	929,834	1,786,738	2,801,872	4,899,035	5,289,444	9,950,099	12,285,094	26,469,418	9,949,757

United States of America v. Christopher Finazzo and Douglas Dey
South Bay ("SB") and Aéropostale ("Aéro") Comparison-Sales and Gross Profit

Legend:
- SB's sales as % of Aéro's
- SB's adjusted gross profit as % of Aéro's

Year	SB's sales as % of Aéro's	SB's adjusted gross profit as % of Aéro's
1997	0.62%	0.76%
1998	2.80%	3.13%
1999	8.33%	4.25%
2000	8.48%	4.56%
2001	6.93%	5.69%
2002	5.14%	3.25%
2003	6.11%	4.33%
2004	5.21%	3.84%
2005	8.33%	7.30%
2006	6.22%	2.18%
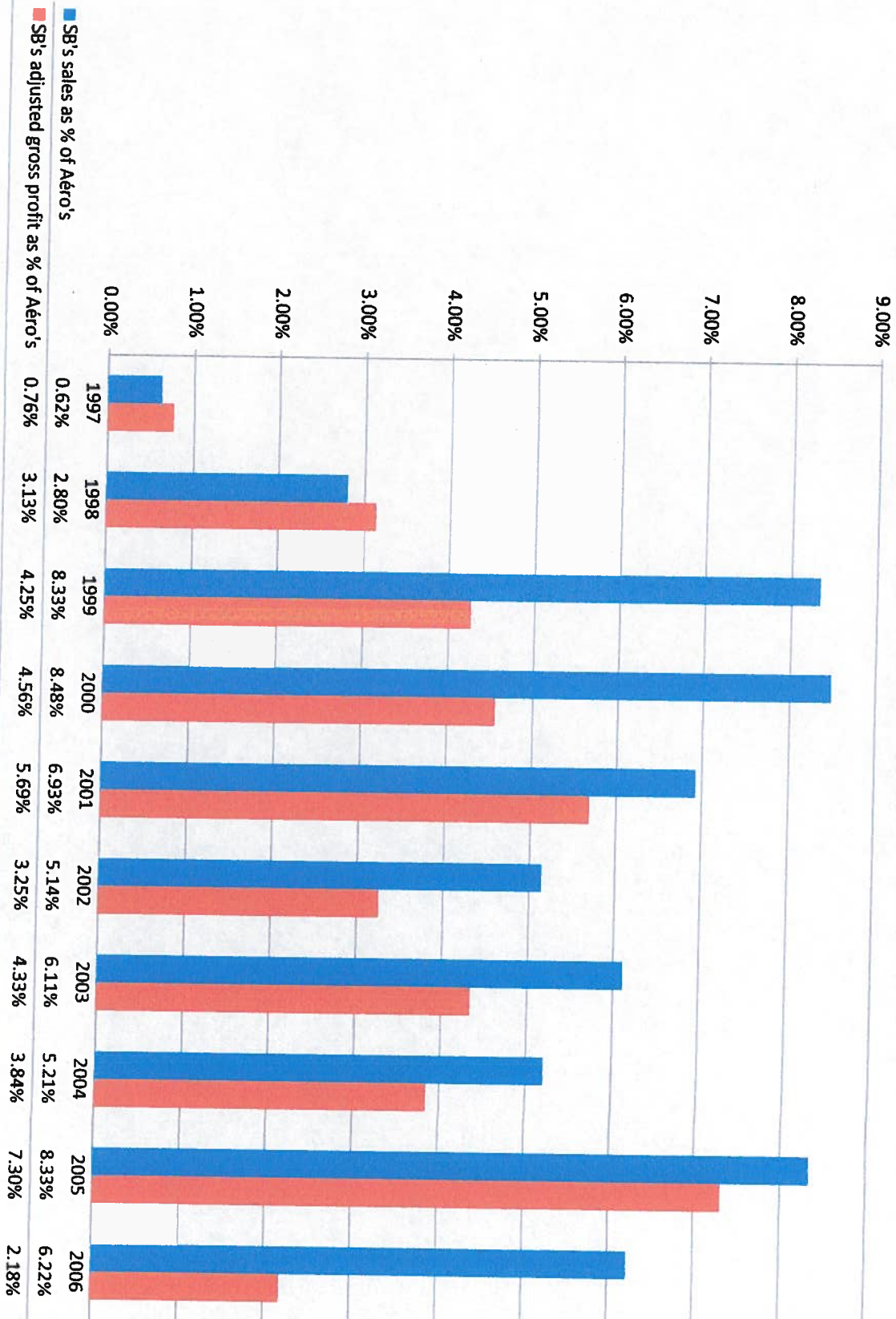
United States of America v. Christopher Finazzo and Douglas Dey
Julian Geiger (CEO) and Christopher L. Finazzo (CMO)
Compensation Comparison

Year	Aéropostale Chief Executive Officer (CEO) compensation	Aéropostale Chief Merchandising Officer (CMO) compensation
2001	769,101	216,314
2002	1,774,831	422,046
2003	2,570,371	1,153,013
2004	4,886,032	1,545,043
2005	2,712,180	952,129
2006	6,432,862	

United States of America v. Christopher Finazzo and Douglas Dey
Aeropostale Sales

Net sales	Year
123,821,000	1997
141,419,000	1998
152,506,000	1999
213,445,000	2000
304,767,000	2001
550,904,000	2002
734,868,000	2003
964,212,000	2004
1,204,347,000	2005
1,413,208,000	2006
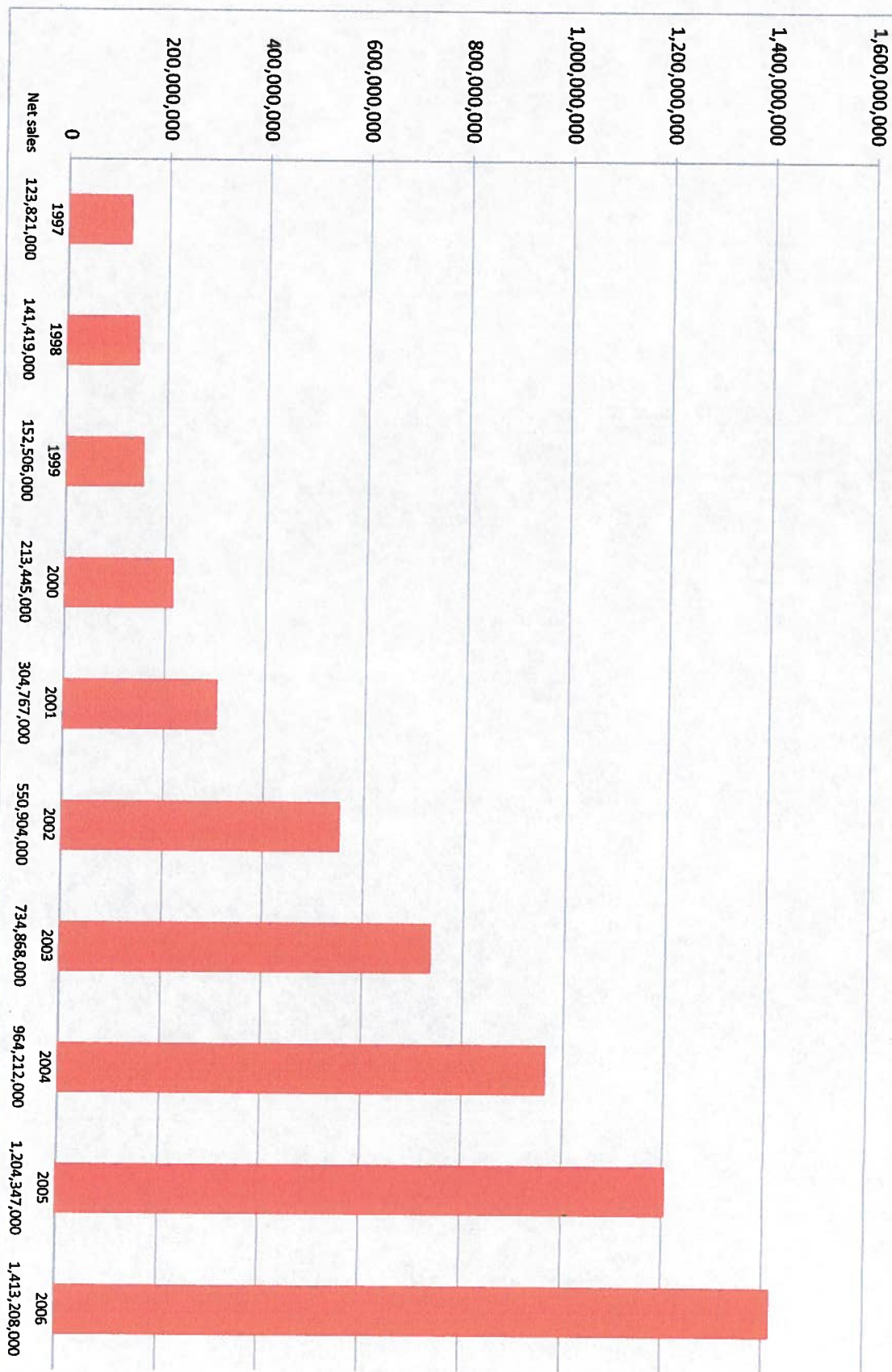
EXHIBIT 5

Aeropostale's Forecasted Gross Profits
South Bay and All Vendors
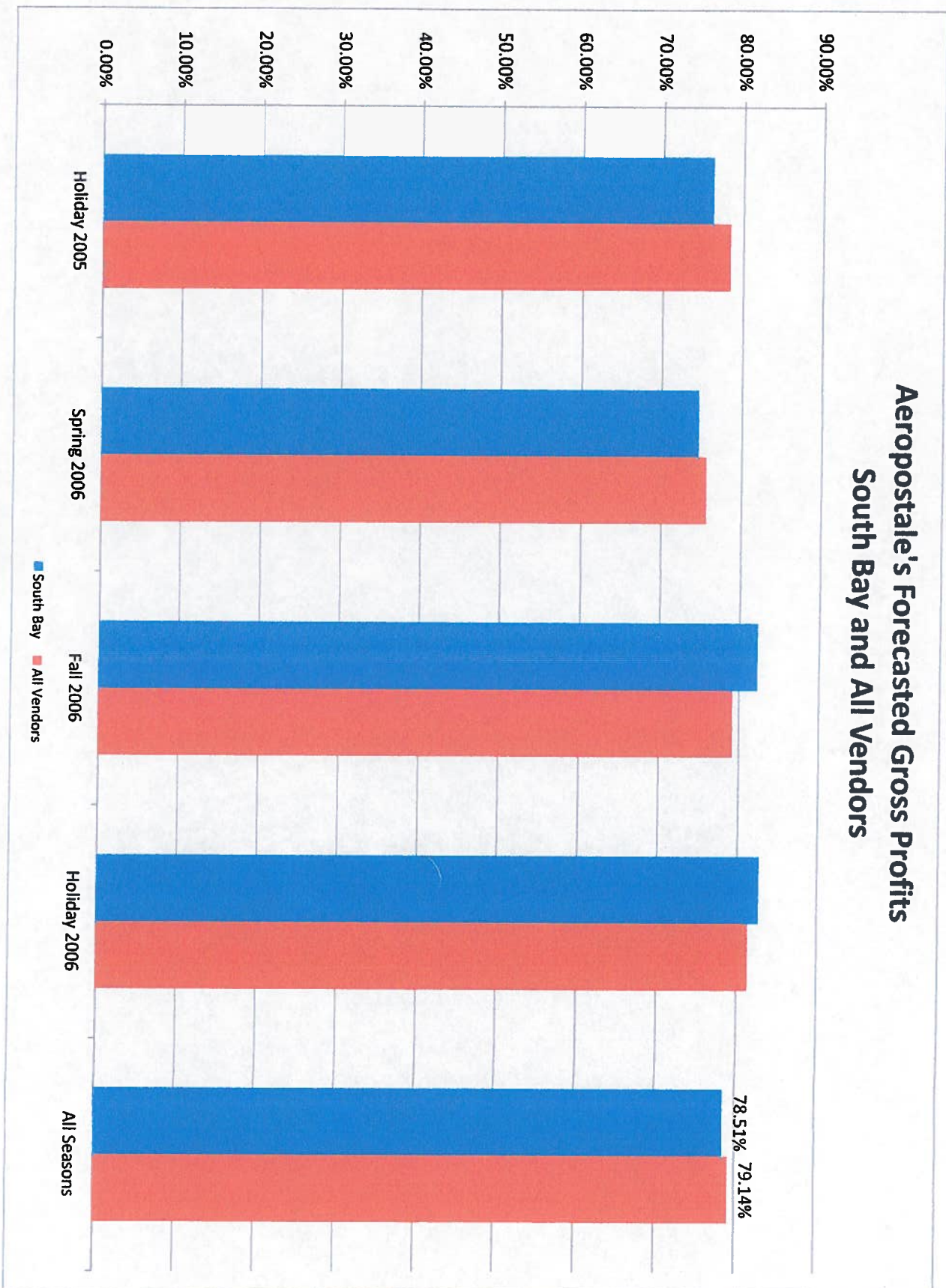
Average of tkt mu		
Season	South Bay	All Vendors
Holiday 2005	76.23%	78.38%
Spring 2006	74.60%	75.64%
Fall 2006	82.27%	79.15%
Holiday 2006	82.70%	81.40%
All Seasons	78.51%	79.14%

Select Finalization Report Analysis

Season	Vendor	Style	file mu	tkt mu	Ref. Page
Spring 2006	sing lun	5k542	76.9%	76.9%	1
Spring 2006	sing lun	8k533	72.9%	72.9%	1
Spring 2006	sing lun	5a720	72.4%	72.4%	1
Spring 2006	sing lun	5k542	76.9%	76.9%	1
Spring 2006	sing lun	5a782	79.2%	79.2%	1
Spring 2006	sing lun	6a713	77.7%	77.7%	1
Spring 2006	sing lun	6j706	76.6%	76.6%	1
Spring 2006	niteks	5k532	73.4%	73.4%	1
Spring 2006	niteks	5k537	76.9%	76.9%	1
Spring 2006	niteks	5k539	76.3%	76.3%	1
Spring 2006	niteks	5k538	73.7%	73.7%	1
Spring 2006	niteks	5k540	75.8%	75.8%	1
Spring 2006	niteks	5k547	76.1%	76.1%	1
Spring 2006	niteks	5a711	75.1%	75.1%	1
Spring 2006	niteks	5a763	77.2%	77.2%	1
Spring 2006	niteks	6a701	74.9%	74.9%	1
Spring 2006	niteks	6a702	74.9%	74.9%	1
Spring 2006	ghim li	5k543	74.0%	74.0%	1
Spring 2006	ghim li	5k544	72.0%	72.0%	1
Spring 2006	ghim li	6k532	73.8%	73.8%	1
Spring 2006	ghim li	5a797	83.7%	83.7%	1
Spring 2006	ghim li	5a720	72.4%	72.4%	1
Spring 2006	ghim li	5a783	74.6%	74.6%	1
Spring 2006	ghim li	5a720	72.4%	72.4%	1
Spring 2006	ghim li	6a712	79.2%	79.2%	1
Spring 2006	ghim li	5j744	81.9%	81.9%	1
Spring 2006	ghim li	5j756	78.9%	78.9%	1
Spring 2006	South Bay	5k541	74.6%	74.6%	1
Spring 2006	yung wah	5k550	75.8%	75.8%	1
Spring 2006	yung wah	5k551	75.8%	75.8%	1
Spring 2006	yung wah	5a740	73.0%	73.0%	1
Spring 2006	yung wah	5a780	73.6%	73.6%	1
Spring 2006	mias	5a774	77.9%	77.9%	1
Spring 2006	mias	5a777	84.4%	84.4%	1
Spring 2006	mias	5a795	80.5%	80.5%	1
Spring 2006	mias	5j742	70.3%	70.3%	1
Spring 2006	mias	5a769	79.2%	79.2%	1
Spring 2006	mias	5a770	75.9%	75.9%	1

Select Finalization Report Analysis

Season	Vendor	Style	file mu	tkt mu	Ref. Page
Spring 2006	mias	5j743	76.2%	76.2%	1
Spring 2006	mias	5a788	75.6%	75.6%	1
Spring 2006	mias	8j707	73.6%	73.6%	1
Spring 2006	mias	5j792	76.2%	76.2%	1
Spring 2006	mias	6j714	82.1%	82.1%	1
Spring 2006	colitex	5a776	82.1%	82.1%	1
Spring 2006	colitex	5a719	75.1%	75.1%	1
Spring 2006	colitex	5a781	72.8%	72.8%	1
Spring 2006	colitex	6a703	75.7%	75.7%	1
Spring 2006	colitex	5a771	80.5%	80.5%	1
Spring 2006	colitex	5a784	81.7%	81.7%	1
Spring 2006	colitex	5a771	80.5%	80.5%	1
Spring 2006	maxlin	5a739	72.9%	72.9%	1
Spring 2006	maxlin	5a779	72.9%	72.9%	1
Spring 2006	maxlin	4j742	73.4%	73.4%	1
Spring 2006	maxlin	5j765	71.0%	71.0%	1
Spring 2006	maxlin	4j742	73.4%	73.4%	1
Spring 2006	maxlin	5j780	72.9%	72.9%	1
Spring 2006	maxlin	4j742	73.4%	73.4%	1
Spring 2006	maxlin	8j705	71.0%	71.0%	1
Spring 2006	sing lun	5b172	74.4%	74.4%	1
Spring 2006	sing lun	5b172	74.4%	74.4%	1
Spring 2006	niteks	5b170	73.9%	73.9%	1
Spring 2006	niteks	5b174	75.3%	75.3%	1
Spring 2006	niteks	5b180	75.1%	75.1%	1
Spring 2006	niteks	5b175	73.7%	73.7%	2
Spring 2006	niteks	5b179	75.5%	75.5%	2
Spring 2006	ghim li	5b178	74.9%	74.9%	2
Spring 2006	ghim li	5b177	73.6%	73.6%	2
Spring 2006	ghim li	6b152	76.0%	76.0%	2
Spring 2006	mias	5b173	70.0%	70.0%	2
Spring 2006	loyaltex	3j722	74.1%	74.1%	2
Spring 2006	loyaltex	6a756	78.7%	78.7%	2
Spring 2006	loyaltex	3j722	74.1%	74.1%	2
Spring 2006	loyaltex	6j709	74.2%	74.2%	2

Select Finalization Report Analysis

Season	Vendor	Style	file mu	tkt mu	Ref. Page
Fall 2006	ghim li	7702	71.5%	71.5%	3
Fall 2006	ghim li	7702	71.5%	71.5%	3
Fall 2006	ghim li	7702	71.5%	71.5%	3
Fall 2006	ghim li	7759	73.1%	73.1%	3
Fall 2006	ghim li	7752	81.4%	81.4%	3
Fall 2006	ghim li	7752	81.4%	81.4%	3
Fall 2006	ghim li	7756	74.8%	74.8%	3
Fall 2006	ghim li	7766	81.0%	81.0%	3
Fall 2006	ghim li	7766	81.0%	81.0%	3
Fall 2006	ghim li	7766	81.0%	81.0%	3
Fall 2006	ghim li	7747	83.0%	83.0%	3
Fall 2006	ghim li	7538	82.6%	82.6%	3
Fall 2006	ghim li	7541	79.1%	79.1%	3
Fall 2006	ghim li	7543	78.8%	78.8%	3
Fall 2006	ghim li	7445	81.4%	81.4%	3
Fall 2006	ghim li	7569	78.5%	78.5%	3
Fall 2006	ghim li	7565	80.9%	80.9%	3
Fall 2006	ghim li	7565	80.9%	80.9%	3
Fall 2006	ghim li	7550	80.7%	80.7%	3
Fall 2006	ghim li	7443	79.0%	79.0%	3
Fall 2006	colitex	7704	74.1%	74.1%	3
Fall 2006	colitex	7708	74.4%	74.4%	3
Fall 2006	colitex	7744	76.7%	76.7%	3
Fall 2006	colitex	7757	74.1%	74.1%	3
Fall 2006	colitex	7758	73.7%	73.7%	3
Fall 2006	yung wah	7707	73.7%	73.7%	3
Fall 2006	yung wah	7542	81.1%	81.1%	3
Fall 2006	yung wah	7546	80.8%	80.8%	3
Fall 2006	yung wah	7554	79.4%	79.4%	3
Fall 2006	yung wah	7560	81.1%	81.1%	3
Fall 2006	yung wah	7441	81.9%	81.9%	3
Fall 2006	niteks	7743	73.8%	73.8%	3
Fall 2006	niteks	7764	76.9%	76.9%	3
Fall 2006	niteks	7770	72.6%	72.6%	3
Fall 2006	niteks	7538	79.0%	79.0%	3
Fall 2006	niteks	7784	88.2%	88.2%	3
Fall 2006	niteks	7545	78.9%	78.9%	3
Fall 2006	niteks	7568	80.4%	80.4%	3
Fall 2006	niteks	7539	80.9%	80.9%	3
Fall 2006	niteks	7539	80.9%	80.9%	3

Select Finalization Report Analysis

Season	Vendor	Style	file mu	tkt mu	Ref. Page
Fall 2006	niteks	7544	81.0%	81.0%	3
Fall 2006	niteks	7547	79.7%	79.7%	3
Fall 2006	niteks	7567	81.4%	81.4%	3
Fall 2006	niteks	7567	81.4%	81.4%	3
Fall 2006	niteks	7551	80.8%	80.8%	3
Fall 2006	niteks	7575	79.2%	79.2%	3
Fall 2006	niteks	7574	77.2%	77.2%	3
Fall 2006	niteks	7573	81.6%	81.6%	3
Fall 2006	niteks	7572	74.9%	74.9%	3
Fall 2006	niteks	7571	81.6%	81.6%	3
Fall 2006	niteks	7444	81.7%	81.7%	3
Fall 2006	niteks	7444	81.7%	81.7%	3
Fall 2006	niteks	7448	80.0%	80.0%	3
Fall 2006	maxlin	7745	74.5%	74.5%	3
Fall 2006	maxlin	4j742	73.4%	73.4%	3
Fall 2006	maxlin	4j742	73.4%	73.4%	3
Fall 2006	maxlin	4j742	73.4%	73.4%	3
Fall 2006	maxlin	7783	84.1%	84.1%	3
Fall 2006	maxlin	7717	84.1%	84.1%	3
Fall 2006	maxlin	7548	77.3%	77.3%	3
Fall 2006	maxlin	7550	81.1%	81.1%	3
Fall 2006	maxlin	7568	81.5%	81.6%	3
Fall 2006	maxlin	7550	81.1%	81.1%	3
Fall 2006	maxlin	7555	81.4%	81.4%	3
Fall 2006	maxlin	7442	80.9%	80.9%	3
Fall 2006	sing lun	7716	83.4%	83.4%	4
Fall 2006	sing lun	7716	83.4%	83.4%	4
Fall 2006	sing lun	7716	83.4%	83.4%	4
Fall 2006	sing lun	7728	80.6%	80.6%	4
Fall 2006	sing lun	7728	80.6%	80.6%	4
Fall 2006	sing lun	7552	82.1%	82.1%	4
Fall 2006	sing lun	7553	82.2%	82.2%	4
Fall 2006	mias	7734	80.8%	80.8%	4
Fall 2006	mias	7742	75.1%	75.1%	4
Fall 2006	mias	7775	83.5%	83.5%	4
Fall 2006	mias	7775	83.5%	83.5%	4
Fall 2006	mias	7776	84.1%	84.1%	4
Fall 2006	mias	7776	84.1%	84.1%	4
Fall 2006	mias	7536	81.5%	81.8%	4
Fall 2006	mias	7533	82.3%	82.3%	4

Select Finalization Report Analysis

Season	Vendor	Style	file mu	tkt mu	Ref. Page
Fall 2006	mias	7534	79.7%	79.7%	4
Fall 2006	mias	7564	82.3%	82.3%	4
Fall 2006	mias	7773	86.3%	86.3%	4
Fall 2006	mias	7701	74.5%	74.5%	4
Fall 2006	mias	7725	72.4%	72.4%	4
Fall 2006	mias	7753	74.8%	74.8%	4
Fall 2006	mias	7753	74.8%	74.8%	4
Fall 2006	mias	7787	86.9%	86.9%	4
Fall 2006	mias	7782	82.8%	82.8%	4
Fall 2006	mias	7783	77.4%	77.4%	4
Fall 2006	mias	7748	84.7%	84.7%	4
Fall 2006	mias	7780	82.6%	82.6%	4
Fall 2006	mias	7780	84.9%	84.9%	4
Fall 2006	mias	7700	84.9%	84.9%	4
Fall 2006	mias	7779	80.3%	80.3%	4
Fall 2006	mias	7779	80.3%	80.3%	4
Fall 2006	mias	7779	80.3%	80.3%	4
Fall 2006	mias	7778	84.1%	84.1%	4
Fall 2006	mias	7778	84.1%	84.1%	4
Fall 2006	mias	7746	80.4%	80.4%	4
Fall 2006	mias	7440	81.6%	81.6%	4
Fall 2006	mias	7440	81.6%	81.6%	4
Fall 2006	mias	7440	81.6%	81.6%	4
Fall 2006	loyaltex	7707	76.7%	76.7%	4
Fall 2006	loyaltex	7714	75.9%	75.9%	4
Fall 2006	loyaltex	7732	72.4%	72.4%	4
Fall 2006	loyaltex	7739	71.4%	71.4%	4
Fall 2006	loyaltex	7739	71.4%	71.4%	4
Fall 2006	loyaltex	7739	71.4%	71.4%	4
Fall 2006	loyaltex	3722	74.1%	74.1%	4
Fall 2006	loyaltex	2722	74.1%	74.1%	4
Fall 2006	loyaltex	3722	74.1%	74.1%	4
Fall 2006	loyaltex	7755	74.5%	74.5%	4
Fall 2006	loyaltex	7761	58.8%	58.8%	4
Fall 2006	South Bay	7555	82.7%	82.7%	4
Fall 2006	South Bay	7587	82.7%	82.7%	4
Fall 2006	South Bay	7561	81.4%	81.4%	4
Holiday 2005	singlun	4a710	79.4%	79.4%	5
Holiday 2005	ghim li	4a711	78.9%	78.9%	5
Holiday 2005	niteks	4a712	79.8%	79.8%	5

Select Finalization Report Analysis

Season	Vendor	Style	file mu	tkt mu	Ref. Page
Holiday 2005	singlun	4a713	77.3%	77.3%	5
Holiday 2005	mias	4a714	80.6%	80.6%	5
Holiday 2005	mias	4a720	80.3%	80.3%	5
Holiday 2005	frc	4a780	76.5%	76.5%	5
Holiday 2005	niteks	4a715	80.0%	80.0%	5
Holiday 2005	yurnosa	4a733	80.3%	80.3%	5
Holiday 2005	yurnosa	4a734	77.1%	77.1%	5
Holiday 2005	sing lun	4a735	79.2%	79.2%	5
Holiday 2005	yung wan	4a736	77.9%	77.9%	5
Holiday 2005	niteks	4a737	79.4%	79.4%	5
Holiday 2005	niteks	4a781	80.9%	80.9%	5
Holiday 2005	mias	4a782	79.9%	79.9%	5
Holiday 2005	maxlin	4a783	82.5%	82.5%	5
Holiday 2005	ghim li	5a712	80.0%	80.0%	5
Holiday 2005	ghim li	5a713	81.2%	81.2%	5
Holiday 2005	yung wan	5a720	84.0%	84.0%	5
Holiday 2005	yurnosa	5a747	78.4%	78.4%	5
Holiday 2005	ghim li	5a748	82.0%	82.0%	5
Holiday 2005	niteks	5a715	80.0%	80.0%	5
Holiday 2005	ghim li	5a725	84.7%	84.7%	5
Holiday 2005	niteks	5a746	78.5%	78.5%	5
Holiday 2005	yurnosa	5a761	79.7%	79.7%	5
Holiday 2005	niteks	5a762	76.9%	76.9%	5
Holiday 2005	niteks	5a764	79.1%	79.1%	5
Holiday 2005	maxlin	5a765	78.9%	78.9%	5
Holiday 2005	South Bay	4a764	77.2%	77.2%	5
Holiday 2005	South Bay	4a765	77.2%	77.2%	5
Holiday 2005	South Bay	4a773	77.2%	77.2%	5
Holiday 2005	South Bay	4a774	75.5%	75.5%	5
Holiday 2005	South Bay	4a775	77.2%	77.2%	5
Holiday 2005	South Bay	4a778	77.2%	77.2%	5
Holiday 2005	South Bay	4a762	77.2%	77.2%	5
Holiday 2005	South Bay	4a763	77.2%	77.2%	5
Holiday 2005	South Bay	4a777	77.2%	77.2%	5
Holiday 2005	South Bay	4a778	77.2%	77.2%	5
Holiday 2005	South Bay	4a779	77.2%	77.2%	5
Holiday 2005	South Bay	5a727	64.9%	64.9%	5
Holiday 2005	South Bay	5a728	75.5%	75.5%	5
Holiday 2005	South Bay	5a730	77.2%	77.2%	5
Holiday 2005	South Bay	5a729	77.2%	77.2%	5
Holiday 2005	South Bay	5a731	77.2%	77.2%	5
Holiday 2005	South Bay	5a732	75.5%	75.5%	5

Select Finalization Report Analysis

Season	Vendor	Style	file mu	tkt mu	Ref. Page
Holiday 2005	South Bay	5a733	77.2%	77.2%	5
Holiday 2006	South Bay	8519	82.7%	82.7%	6
Holiday 2006	South Bay	8516	82.7%	82.7%	6
Holiday 2006	South Bay	8520	82.7%	82.7%	6
Holiday 2006	South Bay	8521	82.7%	82.7%	6
Holiday 2006	South Bay	8522	82.7%	82.7%	6
Holiday 2006	South Bay	8515	82.7%	82.7%	6
Holiday 2006	South Bay	8523	82.7%	82.7%	6
Holiday 2006	South Bay	8524	82.7%	82.7%	6
Holiday 2006	sing lun	8551	83.1%	83.1%	6
Holiday 2006	sing lun	8552	82.7%	82.7%	6
Holiday 2006	sing lun	8585	78.3%	78.3%	6
Holiday 2006	sing lun	8586	80.3%	80.3%	6
Holiday 2006	sing lun	8598	82.0%	82.0%	6
Holiday 2006	sing lun	8402	82.8%	82.8%	6
Holiday 2006	sing lun	8759	84.0%	84.0%	6
Holiday 2006	sing lun	8750	84.0%	84.0%	6
Holiday 2006	sing lun	8772	76.9%	76.9%	6
Holiday 2006	sing lun	8775	82.1%	82.1%	6
Holiday 2006	sing lun	8778	83.2%	83.2%	6
Holiday 2006	niteks	8554	80.4%	80.4%	6
Holiday 2006	niteks	8555	79.7%	79.7%	6
Holiday 2006	niteks	8559	80.4%	80.4%	6
Holiday 2006	niteks	8581	80.3%	80.3%	6
Holiday 2006	niteks	8587	80.9%	80.9%	6
Holiday 2006	niteks	8587	80.9%	80.9%	6
Holiday 2006	niteks	8578	73.4%	73.4%	6
Holiday 2006	niteks	8590	83.0%	83.0%	6
Holiday 2006	niteks	8518	79.6%	79.6%	6
Holiday 2006	niteks	8559	80.4%	80.4%	6
Holiday 2006	niteks	8574	82.0%	82.0%	6
Holiday 2006	niteks	8409	82.5%	82.5%	6
Holiday 2006	niteks	5410	82.5%	82.5%	6
Holiday 2006	niteks	8414	81.2%	81.2%	6
Holiday 2006	niteks	8403	83.2%	83.2%	6
Holiday 2006	niteks	8415	84.4%	84.4%	6
Holiday 2006	niteks	8415	84.4%	84.4%	6
Holiday 2006	niteks	8416	82.2%	82.2%	6
Holiday 2006	niteks	8753	84.9%	84.9%	6
Holiday 2006	niteks	8753	84.9%	84.9%	6

Select Finalization Report Analysis

Season	Vendor	Style	file mu	tkt mu	Ref. Page
Holiday 2006	niteks	8757	76.7%	76.7%	6
Holiday 2006	niteks	8757	76.7%	76.7%	6
Holiday 2006	niteks	8751	79.2%	79.2%	6
Holiday 2006	niteks	8783	77.1%	77.1%	6
Holiday 2006	niteks	8777	79.8%	79.8%	6
Holiday 2006	niteks	8778	86.7%	86.7%	6
Holiday 2006	niteks	8770	86.7%	86.7%	6
Holiday 2006	ghim li	8558	79.9%	79.9%	6
Holiday 2006	ghim li	8558	79.9%	79.9%	6
Holiday 2006	ghim li	8589	78.7%	78.7%	6
Holiday 2006	ghim li	8573	80.3%	80.3%	6
Holiday 2006	ghim li	8585	82.4%	82.4%	6
Holiday 2006	ghim li	8594	77.5%	77.5%	6
Holiday 2006	ghim li	8586	80.4%	80.4%	6
Holiday 2006	ghim li	8572	82.4%	82.4%	6
Holiday 2006	ghim li	8584	80.9%	80.9%	6
Holiday 2006	ghim li	8412	79.6%	79.6%	6
Holiday 2006	ghim li	8706	83.7%	83.7%	6
Holiday 2006	ghim li	8706	83.7%	83.7%	6
Holiday 2006	ghim li	8768	77.2%	77.2%	6
Holiday 2006	ghim li	8768	77.2%	77.2%	6
Holiday 2006	ghim li	8722	80.9%	80.9%	6
Holiday 2006	ghim li	8722	80.9%	80.9%	6
Holiday 2006	ghim li	8782	79.9%	79.9%	6
Holiday 2006	ghim li	8782	79.9%	79.9%	6
Holiday 2006	ghim li	8782	79.9%	79.9%	6
Holiday 2006	ghim li	8782	79.9%	79.9%	6
Holiday 2006	ghim li	8793	83.9%	83.9%	6
Holiday 2006	ghim li	8793	83.9%	83.9%	6
Holiday 2006	ghim li	8793	83.9%	83.9%	6
Holiday 2006	ghim li	8793	83.9%	83.9%	6
Holiday 2006	ghim li	8743	85.3%	85.3%	6
Holiday 2006	ghim li	8781	85.3%	85.3%	6
Holiday 2006	frc	8560	76.5%	76.5%	7
Holiday 2006	yung wan	8575	83.0%	83.0%	7
Holiday 2006	yung wan	8581	79.6%	79.6%	7
Holiday 2006	yung wan	8582	81.9%	81.9%	7
Holiday 2006	yung wan	8404	83.7%	83.7%	7
Holiday 2006	yung wan	8407	82.2%	82.2%	7
Holiday 2006	yung wan	8411	82.6%	82.6%	7

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Season	Vendor	Style	file mu	tkt mu	Ref. Page
Holiday 2006	yung wan	8409	83.3%	83.3%	7
Holiday 2006	yung wan	8794	84.1%	84.1%	7
Holiday 2006	yung wan	8773	84.9%	84.9%	7
Holiday 2006	yung wan	8756	76.7%	76.7%	7
Holiday 2006	yung wan	8784	76.7%	76.7%	7
Holiday 2006	yung wan	8785	76.7%	76.7%	7
Holiday 2006	yung wan	8701	78.2%	78.2%	7
Holiday 2006	maxlin	8587	81.5%	81.6%	7
Holiday 2006	maxlin	8417	83.5%	83.5%	7
Holiday 2006	maxlin	8760	83.7%	83.7%	7
Holiday 2006	maxlin	4742	80.0%	80.0%	7
Holiday 2006	maxlin	4742	80.0%	80.0%	7
Holiday 2006	maxlin	4742	80.0%	80.0%	7
Holiday 2006	maxlin	4742	80.0%	80.0%	7
Holiday 2006	maxlin	8748	78.7%	78.7%	7
Holiday 2006	kie & kie	8733	80.1%	80.1%	7
Holiday 2006	kie & kie	8733	80.1%	80.1%	7
Holiday 2006	kie & kie	8769	78.0%	78.0%	7
Holiday 2006	kie & kie	8769	78.0%	78.0%	7
Holiday 2006	kie & kie	8771	83.6%	83.6%	7
Holiday 2006	kie & kie	8771	83.6%	83.6%	7
Holiday 2006	kie & kie	8789	82.0%	82.5%	7
Holiday 2006	kie & kie	8789	82.6%	82.6%	7
Holiday 2006	kie & kie	8767	86.7%	86.7%	7
Holiday 2006	kie & kie	8738	84.3%	84.3%	7
Holiday 2006	kie & kie	8779	83.3%	83.3%	7
Holiday 2006	kie & kie	7782	82.8%	82.8%	7
Holiday 2006	kie & kie	8707	84.1%	84.1%	7
Holiday 2006	kie & kie	8711	84.1%	84.1%	7
Holiday 2006	kie & kie	8707	84.1%	84.1%	7
Holiday 2006	loyaltex	8758	81.3%	81.3%	7
Holiday 2006	loyaltex	8758	81.3%	81.3%	7
Holiday 2006	loyaltex	7739	78.7%	78.7%	7
Holiday 2006	loyaltex	7739	78.7%	78.7%	7
Holiday 2006	loyaltex	7739	78.7%	78.7%	7
Holiday 2006	loyaltex	8736	76.4%	76.4%	7
Holiday 2006	loyaltex	8780	80.8%	80.8%	7
Holiday 2006	loyaltex	8712	87.6%	87.6%	7
Holiday 2006	colitex	8761	85.5%	85.5%	7

Select Finalization Report Analysis

Season	Vendor	Style	file mu	tkt mu	Ref. Page
Holiday 2006	colitex	8788	77.4%	77.4%	7
Holiday 2006	colitex	8788	77.4%	77.4%	7
Holiday 2006	colitex	8774	84.3%	84.3%	7
Holiday 2006	colitex	8703	79.6%	79.6%	7
Holiday 2006	colitex	8702	79.6%	79.6%	7
Holiday 2006	colitex	8750	79.9%	79.9%	7
Holiday 2006	colitex	8753	81.1%	81.1%	7
Holiday 2006	colitex	8754	81.1%	81.1%	7
Holiday 2006	passport	8709	83.9%	83.9%	7
Holiday 2006	passport	8709	83.9%	83.9%	7

EXHIBIT 6

The Value of Fast Fashion: Quick Response, Enhanced Design, and Strategic Consumer Behavior

Gérard P. Cachon
The Wharton School, University of Pennsylvania, Philadelphia, Pennsylvania 19104, cachon@wharton.upenn.edu

Robert Swinney
Graduate School of Business, Stanford University, Stanford, California 94305, swinney@stanford.edu

A fast fashion system combines quick response production capabilities with enhanced product design capabilities to both design "hot" products that capture the latest consumer trends and exploit minimal production lead times to match supply with uncertain demand. We develop a model of such a system and compare its performance to three alternative systems: quick-response-only systems, enhanced-design-only systems, and traditional systems (which lack both enhanced design and quick response capabilities). In particular, we focus on the impact of each of the four systems on "strategic" or forward-looking consumer purchasing behavior, i.e., the intentional delay in purchasing an item at the full price to obtain it during an end-of-season clearance. We find that enhanced design helps to mitigate strategic behavior by offering consumers a product they value more, making them less willing to risk waiting for a clearance sale and possibly experiencing a stockout. Quick response mitigates strategic behavior through a different mechanism: by better matching supply to demand, it reduces the chance of a clearance sale. Most importantly, we find that although it is possible for quick response and enhanced design to be either complements or substitutes, the complementarity effect tends to dominate. Hence, when both quick response and enhanced design are combined in a fast fashion system, the firm typically enjoys a greater incremental increase in profit than the sum of the increases resulting from employing either system in isolation. Furthermore, complementarity is strongest when customers are very strategic. We conclude that fast fashion systems can be of significant value, particularly when consumers exhibit strategic behavior.

1. Introduction

Firms in the fashion apparel industry—such as Zara, H&M, and Benetton—have increasingly embraced the philosophy of "fast fashion" retailing (Passariello 2008, Rohwedder and Johnson 2008). Generally speaking, a fast fashion system combines at least two components:

1. short production and distribution lead times, enabling a close matching of supply with uncertain demand (which we refer to as *quick response* techniques);

2. highly fashionable ("trendy") product design (which we refer to as *enhanced design* techniques).

Short lead times are enabled through a combination of localized production, sophisticated information systems that facilitate frequent inventory monitoring and replenishment, and expedited distribution methods. For example, Zara, primarily a European retailer, produces the majority of its designs in costly European and North African factories (rather than outsourcing to less expensive Asian facilities), and continuously monitors inventory levels in stores

to effectively match supply and demand (Ghemawat and Nueno 2003, Ferdows et al. 2004). The second component (trendy product design) is made possible by carefully monitoring consumer and industry tastes for unexpected fads and reducing design lead times. Benetton, for example, employs a network of "trend spotters" and designers throughout Europe and Asia, and also pays close attention to seasonal fashion shows in Europe (Meichtry 2007).[1]

From an operational perspective, quick response strategies have been relatively well studied, and are known to yield significant value to firms by better matching supply and demand (see, e.g., Fisher and Raman 1996, Eppen and Iyer 1997, Caro and Martínez-de-Albéniz 2010, Caro and Gallien 2010) and by influencing consumer purchasing behavior by reducing the frequency and severity of season-ending clearance sales (Cachon and Swinney 2009). However, the second component of fast fashion systems—creating trendy, highly fashionable products—has

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[1] There are other aspects of fast fashion systems that we do not consider, notably frequent changes in product assortment.

received far less attention. Indeed, despite the intense recent interest in lead time reduction, Meichtry (2007) describes how some firms are attempting to focus on design and develop trendier products without reducing their production lead times because of the difficulties (both logistical and cultural) that can accompany drastically redesigning the supply network.

In this paper, we develop a framework that allows us to address the value of such enhanced design strategies and, subsequently, to consider the impact of combining both quick response and enhanced design in a fast fashion system. We postulate that, all else being equal, enhanced design capabilities result in products that are of greater value to consumers and hence elicit a greater willingness to pay. Consequently, firms may exploit this greater willingness to pay by charging higher prices on "trendy" products than on more conservative products. Enhanced design capabilities are costly, however: there are typically fixed costs (a large design staff, trend spotters, rapid prototyping capabilities, etc.), and there may be greater variable costs (e.g., because of more labor-intensive production processes or costly local labor). Thus, as with any operational strategy, firms considering enhanced design must trade off the benefits of the strategy (greater consumer willingness to pay) with the costs (fixed and variable).

A central issue that we address is the impact of enhanced design and quick response on consumer purchasing behavior. Particularly in the fashion apparel industry, the propensity of consumers to anticipate future markdowns and intentionally delay purchasing until a sale occurs is a well documented and widespread problem (Rozhon 2004). This behavior erodes retailer margins and can drastically reduce profitability. Both enhanced design and quick response have frequently been cited as effective tools for retailers to combat such "strategic" customer behavior (see, e.g., Ghemawat and Nueno 2003). Such systems, we demonstrate, decrease consumer incentives to wait for clearance sales in two key ways. Quick response reduces the chance that inventory will remain to be sold at the clearance price (because quick response more closely matches supply and demand; see Cachon and Swinney 2009). Enhanced product design, on the other hand, gives customers a trendier product that they value more, making them less willing to risk waiting for a sale if there is any chance that the item will stock out. Thus, whereas quick response decreases the expected *future* utility of waiting for a price reduction, enhanced design increases the *immediate* utility of buying the product at the full price. By decreasing consumer incentives to wait for the clearance sale, both enhanced design and quick response allow the firm to set a higher selling price while still inducing consumers to pay the full price.

Because the two techniques are increasingly used in combination in fast fashion systems, a key question is how the two practices interact and influence one another's value; in particular, we consider whether enhanced design and quick response are substitutes (i.e., implementing one practice reduces the marginal worth of the other) or complements (i.e., implementing one practice increases the marginal worth of the other; Milgrom and Roberts 1990). Whether quick response and enhanced design are complements or substitutes has important consequences for the profitability of fast fashion systems versus alternative systems (e.g., a system with only quick response or enhanced design, but not both), and moreover it is critical to determine whether the efforts of firms described by Meichtry (2007) to focus on implementing only one aspect of fast fashion are prudent: as discussed by Milgrom and Roberts (1990), complementary strategies should be adopted simultaneously, whereas substitutable strategies are more likely to be adopted in isolation.

At first glance, it may appear that the answer to the complementarity question is straightforward. Enhanced design results in more consumer value and higher selling prices, so eliminating lost sales becomes more important to the firm with enhanced design (because in each lost sale, the firm will lose out on a higher margin). This implies that adding quick response to an enhanced design system may result in greater incremental value than implementing quick response alone, leading to a complementarity effect.

Our model confirms that this reasoning is correct and, in the absence of strategic consumer behavior, typically results in quick response and enhanced design being complements. When customers behave strategically, however, we also identify a substitution effect that arises between quick response and enhanced design. This effect is rooted in the fact that the two practices independently influence consumer purchasing behavior in a similar way: as discussed above, when customers exhibit strategic behavior, both quick response and enhanced design can generate value to the firm by reducing consumer incentives to delay a purchase. In what follows, we show that the behavioral effect of quick response reduces the efficacy of the behavioral effect of enhanced design, meaning the practices can behave as substitutes along this dimension.

As a result of this behavioral substitution effect, quick response and enhanced design can be either net complements or substitutes. In the following analysis, we discuss conditions that dictate the direction of this relationship. We find that although substitution is possible—particularly if enhanced design is costly on a marginal basis—under most reasonable conditions the two practices are complements. Thus,

when employing both strategies in a fast fashion system, the firm typically enjoys a superadditive increase in profit relative to employing the strategies in isolation. Furthermore, via numerical experiments we show that the complementarity effect is strongest if customers are highly strategic. These results help to demonstrate that, although it may be tempting for firms to only invest in one aspect of fast fashion (either quick response or enhanced design), there is less value in doing so than in pursuing both strategies together—potentially far less value, if consumers are highly strategic.

The remainder of this paper is organized as follows. Section 2 reviews the relevant literature, and §3 describes a basic model and analyzes a system with neither quick response nor enhanced design. Sections 4 and 5 discuss the impact of employing quick response and enhanced design in isolation, and §§6 and 7 consider the combination of both components in a fast fashion system. Section 8 reports the results of an extensive numerical study, and §9 concludes this paper with a discussion of the results.

2. Literature Review

There are two primary streams of research that relate to our analysis: the literature on operational flexibility with nonstrategic customers (in particular, quick response and postponement practices) and the literature on strategic consumer purchasing behavior. Quick response has received a large amount of attention—see, e.g., Fisher and Raman (1996), Eppen and Iyer (1997), Iyer and Bergen (1997), Fisher et al. (2001), and the Sport Obermeyer case study by Hammond and Raman (1994). Each of these works describes the benefit of reducing supply–demand mismatches by providing the firm with an option to procure inventory after learning updated demand information. More recent works, such as Li and Ha (2008) and Caro and Martínez-de-Albéniz (2010), address the impact of competition on quick response inventory practices. Postponement—the practice of delaying final assembly—also seeks to provide higher product availability with a lower inventory investment; see Lee and Tang (1997), Feitzinger and Lee (1997), Goyal and Netessine (2007), and Anand and Girotra (2007). The distinction between postponement and enhanced design is one of degree. Postponement creates variants from a base model (e.g., different color panels for the same phone), whereas enhanced design creates significantly different product variants from component inventory (e.g., a skirt or dress slacks from the same material). Neither the papers on quick response nor postponement analytically address the impact of quick response or enhanced design on strategic consumer behavior.

The issue of strategic (or rational) customer purchasing behavior dates to Coase (1972) and the theory of durable goods pricing in monopolies. The Coase conjecture, which was described informally by Coase (1972) and formalized by Stokey (1981) and Bulow (1982), states that in the face of infinitely patient consumers, a monopolist can charge a price no higher than marginal cost, because consumers will patiently wait as long as possible for the price to be reduced to its lowest level.

More recently, a stream of research has emerged that explores the role of supply and demand mismatch in influencing strategic consumer purchasing behavior. Liu and van Ryzin (2008) show that a firm may wish to understock to generate shortages when prices decline over time and consumers may strategically wait for the sale. Aviv and Pazgal (2008) examine the value of dynamic and static pricing schemes in a revenue management setting with stochastically arriving strategic customers. Yin et al. (2009) consider the impact of in-store display formats (e.g., displaying all units or displaying one unit to limit consumer information about inventory availability) on the consumer incentive to strategically delay purchasing. Su and Zhang (2008) show that when the sale price is exogenously set, the firm reduces inventory and sets a lower full price to induce strategic consumers to purchase at the full price. Other aspects of the strategic consumer purchasing problem that have been addressed include availability guarantees in Su and Zhang (2009), product returns in Su (2009), and consumer stockpiling in Su (2010). Although many of these papers consider the inventory decision of the firm, none addresses the interaction of quick response, enhanced design, or fast fashion systems with consumer purchasing.

Cachon and Swinney (2009) and Swinney (2010) do address the impact of quick response on strategic consumer purchasing. Cachon and Swinney (2009) show that the presence of strategic consumers can enhance the value of quick response beyond just matching supply with demand—adopting quick response reduces the likelihood of deep discounts, which makes strategic consumers more willing to purchase at the regular price. In Swinney (2010), the impact of quick response in markets where consumers learn about product value over time is explored, and it is shown that quick response may decrease or increase the firm's profit, depending on characteristics of the selling environment (e.g., whether consumer returns are allowed or whether the firm prices dynamically). Unlike the present analysis, these papers do not address the impact of enhanced design on consumer purchasing behavior nor the interaction between enhanced design and quick response to generate a fast fashion retail system.

3. The Traditional System

To stimulate our analysis of the incremental value of the components of a fast fashion system, we analyze a total of four potential operational systems. A *traditional system*, abbreviated T, represents a typical firm with long production lead times and standard product design abilities. As we will reveal below, this system most closely resembles a newsvendor model. A *quick response system*, abbreviated Q, does not employ enhanced design capabilities, but does yield significantly reduced production lead times. An *enhanced design system*, abbreviated D, employs enhanced design capabilities (and hence greater consumer willingness to pay) but maintains long production lead times—this system resembles the efforts described by Meichtry (2007) to focus on product design while avoiding the kind of radical supply chain overall necessary to achieve lead time reduction. Finally, a *fast fashion system*, abbreviated F, employs both quick response and enhanced design capabilities. The fast fashion system resembles the mode of operations increasingly found in retailers such as Zara, Benetton, and H&M. The characteristics of these systems are summarized in Table 1.

One could argue that short production lead times *should* increase the efficacy of creating trendy products by allowing designs to be finalized closer to the selling season. For example, many traditional fashion retailers (such as Gap) have average design and production lead times on the order of 6 to 12 months. If these firms intensified their product design efforts without reducing production lead times, although they may be able to generate better products overall, they would still have to make final design decisions months in advance of the selling season (and consequently well in advance of the revelation of any unexpected trends). On the other hand, a fast fashion firm has dramatically shorter design-to-shelf lead times—in some cases, on the order of weeks—and so such firms can observe and replicate trends practically in real time. Thus, enhanced design efforts presumably result in an even greater increase in consumer willingness to pay if the firm simultaneously achieves lead time reduction. We take a conservative approach on this issue: we assume that adopting enhanced design capabilities results in an identical increase in consumer willingness to pay *regardless* of the production lead time of the firm. In other words, we do not assume ex ante that any complementarity exists

between enhanced design efforts and quick response capabilities—we discuss the impact of this assumption in the conclusion of this paper.

In each possible system depicted in Table 1, we analyze a game between a firm and its consumers. The firm chooses the selling price and the inventory level, whereas consumers choose whether to buy at the full price or wait for a potential clearance sale (running the risk that the product might run out). In this section, we introduce the basic model and analyze the case of the traditional system—that is, a system possessing neither quick response nor enhanced design. This model will serve as a base case, upon which we will expand to analyze the three alternative systems.

3.1. The Model

A single firm sells a single product over a finite season. The market is characterized by demand uncertainty: the total number of consumers in the market is stochastic and denoted by the continuous random variable N with distribution $F(\cdot)$ and mean μ. Consumers have homogenous value v for the product.

The product is sold over a single season. Prior to the start of the selling season (and prior to learning market size), the firm makes an inventory procurement q at unit cost c and sets a selling price, p, to maximize expected profit, $\pi(q, p)$. At the end of the season, all remaining inventory is cleared at an exogenous salvage or "sale" price s, where $s < c$.[2]

Customers are strategic to the extent that they are forward-looking: they recognize that the product will eventually be reduced in price and consider delaying their purchase until the price is lowered. Customers discount future consumption at a rate $\delta \in [0, 1]$. By delaying a purchase until the clearance sale, customers lose out on some consumptive value, and hence their future utility is reduced to reflect this loss. In addition, δ may be thought of as the level of strategic behavior or patience of the customer population (higher δ implies more patient or strategic consumers), or as a proxy for the durability of the good (higher δ implies a more durable good with greater future value). For the remainder of this paper, we adopt the convention that greater δ implies a "more strategic customer population," with the understanding that the factors influencing this may be related to the product itself, overall market or industry conditions, or intrinsic consumer characteristics.

[2] Su and Zhang (2008) also assume that the clearance price s is exogenous and common knowledge (e.g., it may be the customary sale price in the industry or for the firm, or it may be the prevailing price of a secondary salvage market that is accessible to consumers as well as the firm). An alternative model would allow the firm to dynamically set a sale price at the end of the regular season; for a model with heterogeneous customers and dynamic sale pricing coupled with quick response, see Cachon and Swinney (2009).

Table 1	The Four Possible Production Systems	
	Normal design	Enhanced design
Slow production	*Traditional* (T)	*Enhanced design* (D)
Quick response	*Quick response* (Q)	*Fast fashion* (F)

Figure 1   Sequence of Events in the Traditional System

| Firm: Design finalized and inventory level chosen | Firm: Selling price (p) chosen | Consumers: Arrive and choose to purchase now or wait for the sale | Firm: Remaining inventory marked down to s |

Before the selling season   Selling season
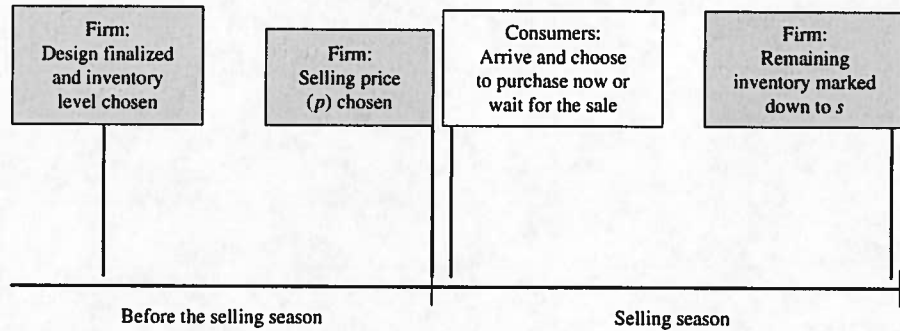
All consumers arrive at the firm at the start of the selling season. After observing the selling price p, each consumer individually chooses to either purchase the product immediately at price p or delay her purchase until the clearance sale. When making this decision, consumers take into account their surplus from an immediate purchase (a function of valuation and price) and their expected surplus from a delayed purchase, which incorporates the clearance price s, the discount factor δ, and the perceived probability of obtaining a unit, which we label ϕ. One of two cases then occurs for each individual consumer. If the firm is out of stock at the full price, the game is over. If the firm is in stock, then the consumer chooses between purchasing at the full price and obtaining the unit for certain, and delaying until the clearance sale and probabilistically obtaining a unit. The surplus of an immediate purchase at price p is $v - p$, whereas the expected surplus of a delayed purchase at the clearance price[3] is $\delta\phi(v - s)$. Consumers subsequently choose to purchase at the price that yields greater expected surplus, and we assume that if consumers are indifferent between the two actions, then they purchase at the full price p.[4] The sequence of events is depicted in Figure 1.

Strategic consumers who choose to delay their purchase are "first in line" in the clearance market—that is, although the firm may dispose of an infinite amount of inventory on the salvage market (implying infinite demand), strategic customers are allocated remaining inventory first, followed by demand from the salvage market.[5] In what follows, we use an asterisk to denote equilibrium values (prices, quantities, profits), and the subscripts T, Q, D, and F to denote specific systems where necessary. We introduce the following notation, which we use throughout the analysis: let $(x)^+ = \max(x, 0)$, let $L(q) = \mathbb{E}(N - q)^+$ be the expected lost sales (excess demand above q), and let $I(q) = \mathbb{E}(q - N)^+$ be the expected leftover inventory (excess inventory above N that is cleared at the sale price s).

Finally, we note here that we do not consider any fixed costs resulting from the implementation of any system (though we will account for increases in variable costs resulting from quick response or enhanced design). Indeed, fixed costs can be significant, particularly in the form of physical infrastructure (factory, warehouse, and distribution systems) and information systems. Directionally, the impact of such fixed costs is clear.

3.2. Equilibrium Inventory and Pricing
To explore the value of the traditional system (and each of the subsequent systems), we analyze a game between the forward-looking customer population and the firm: consumers choose *when to buy* the product (at the full price or at the discounted price) and the firm chooses *how much inventory* to stock and *what price* to charge. We assume that consumers do *not* directly observe the total inventory of the firm

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[3] An alternative model would be consumers who do not discount future consumption, but rather have declining valuations. In that case, the expected surplus of a delayed purchase at the clearance price is $\delta v - s$; see, e.g., Cachon and Swinney (2009). This alternative model results in slightly higher full prices (because consumers consider the full future cost, s, rather than a discounted future cost, δs) but qualitatively similar results to our own.

[4] In particular, if consumers are indifferent between purchasing opportunities, they do not consider randomizing between the two periods; in other words, we do not consider mixed strategies. The reason for this is simple: because our consumers are homogenous, if mixed strategies are allowed and some consumers (randomly) choose to wait for the sale, the firm can simply lower the full price by an arbitrarily small amount to eliminate consumer indifference and induce all consumers to pay the full price. The amount of discounting necessary to achieve this is arbitrarily small and is hence ignored.

[5] This allocation rule is also adopted by Su and Zhang (2008). A more general allocation mechanism in the salvage stage—e.g., random arrivals of strategic customers and customers from the exogeneous salvage market, discussed in Cachon and Swinney (2009)—merely reduces the probability that a consumer receives a unit at the salvage price and is unlikely to qualitatively change the results.

before making their decisions,[6] and consequently the firm cannot credibly convey inventory information to consumers (i.e., the firm is not a leader in a sequential game). Consumers do, however, make their purchasing decisions with a fixed belief about the probability of a clearance sale (ϕ), which is correct in equilibrium—in other words, consumers have rational expectations concerning the average probability of a clearance sale.

We thus seek Nash equilibria in a simultaneous decision game between many players: the firm and a continuum of (identical) consumers. Given that consumers are homogeneous, either all consumers purchase at price p, or all consumers purchase at price s. However, the latter does not lead to an interesting equilibrium: given $s < c$, the firm does not order any inventory. Thus, we are left to derive an equilibrium in which all consumers purchase early. In such an equilibrium, the firm's expected profit as a function of the price p and quantity q is

$$\pi_T(q, p) = (p - s)S(q) - (c - s)q, \tag{1}$$

where $S(q) = \mathbb{E}\min(q, N)$ is expected sales given a quantity x, and the expectation operator $\mathbb{E}$ is taken over market size, N. Given these preliminaries, we may now define the equilibrium to pricing-inventory-purchasing game (which applies to any of the four production systems that we will analyze).

DEFINITION 1. An equilibrium with rational expectations and nonzero production to the game between strategic consumers and the firm satisfies the following:
1. The firm sets price and inventory to maximize expected profit, given that consumers all purchase early.
2. Consumers purchase early, given the selling price and a belief about the probability of a clearance sale.
3. Consumer beliefs about the probability of a clearance sale are rational.

In the traditional system, these conditions are
1. $(q_T^*, p_T^*) = \arg\max_{q, p} \pi_T(q, p)$;
2. $v - p_T^* \geq \delta\phi(v - s)$;
3. $\phi = F(q_T^*)$.
Our model of the traditional system is similar to the model analyzed by Su and Zhang (2008), but our consumers discount future consumption by an arbitrary

amount. This difference results in slightly more complicated expressions for equilibrium price and inventory levels, but nevertheless the equilibrium analysis is qualitatively similar to our own. Define

$$A(v) = v(1 - \delta) + (1 + \delta)s \quad \text{and}$$
$$B(v, c) = sv - \delta c(v - s).$$

We may now solve for the equilibrium in the traditional system:

LEMMA 1. *In a traditional system, an equilibrium with nonzero production exists and is unique. In equilibrium, all consumers purchase early. The equilibrium full price is*

$$p_T^* = \frac{A(v) + \sqrt{[A(v)]^2 - 4B(v, c)}}{2}.$$

PROOF. All proofs appear in the appendix. □

It is clear that the equilibrium price p_T^* is decreasing in the consumer discount factor (δ); hence, the greater the severity of strategic customer behavior (i.e., the less consumers discount future consumption and the greater δ), the lower the firm must set the selling price to induce consumers to purchase at the full price.

4. Quick Response

In the quick response system, the design abilities are standard and the production phase is fast—hence, although the product design process results in lower-value products for consumers, the inventory may be procured after learning total market size. To model quick response, we adopt a stylized model employed by much of the literature; see, e.g., Cachon and Swinney (2009), Fisher and Raman (1996), and Eppen and Iyer (1997). Following this literature, we assume that the firm can procure inventory both before and after receiving a forecast update prior to the start of the selling season. The forecast update is perfectly informative (i.e., reveals the actual demand level) and production is fast enough that all units arrive before the start of the selling season. Inventory procured prior to learning demand information is obtained for a low cost (c, just as in the traditional system in the preceding section), whereas additional inventory procured after learning the realized value of market size incurs an additional cost $c_Q \geq 0$ because of expedited manufacturing and shipping expenses. The sequence of events is depicted in Figure 2.

When making the inventory procurement following the realization of demand information, it is easy to see that as long as the margin on each unit ($p - c - c_Q$) is positive, the optimal action of the firm is to produce precisely enough inventory to cover all full price demand. By the same logic from the traditional system, the only possible candidate equilibrium is one

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[6] Consumers may be incapable of directly observing inventory in a variety of situations, including if the firm is an online retailer, if the firm stocks a particular retail location from a centralized warehouse, or if the firm displays a limited amount of inventory on the store floor.

Figure 2   Sequence of Events in the Quick Response System
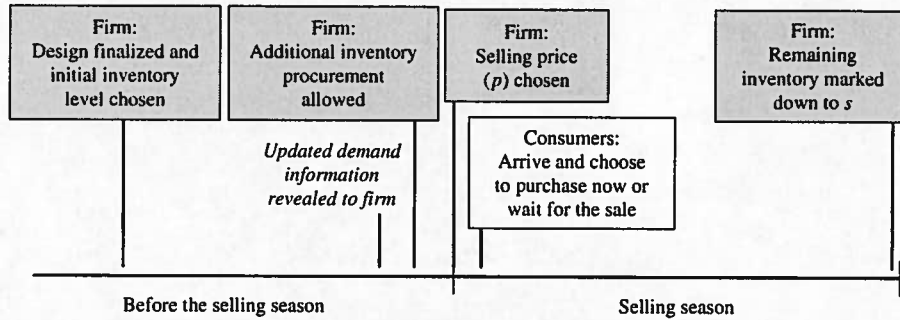
in which all consumers attempt to purchase at the full price. In such an equilibrium, the firm's expected profit with quick response as a function of the initial inventory procurement (q) and price (p) is, supposing $p \geq c + c_Q$,

$$\pi_Q(q, p) = (p - c)\mu - c_Q L(q) - (c - s)I(q).$$

Equilibrium in the quick response system is defined using the same three conditions in Definition 1, adapted to the appropriate profit function for the quick response system. Thus, the three equilibrium conditions with quick response are

1. $(q_Q^*, p_Q^*) = \arg\max_{q, p} \pi_Q(q, p)$;
2. $v - p_Q^* \geq \delta\phi(v - s)$;
3. $\phi = F(q_Q^*)$.

The following lemma solves for this equilibrium.

Lemma 2. *In a quick response system, an equilibrium with nonzero production exists and is unique. In equilibrium, all consumers purchase early. The equilibrium full price is*

$$p_Q^* = v - \delta\frac{c_Q}{c + c_Q - s}(v - s) \qquad (2)$$

if $p_Q^* \geq c + c_Q$, whereas if $p_Q^* < c + c_Q$, the equilibrium is identical to the traditional system.

Because of the option to procure additional inventory at a later date, the firm procures less inventory in the initial buy than in the traditional system, which results in a lower chance that there will be inventory available during the clearance season. Consequently, from a consumer's point of view, the probability of successfully obtaining a unit at the sale price decreases, along with the incentive to wait for the discounted price. In turn, this allows the firm to charge a higher full price while maintaining an equilibrium in which (as we saw in the traditional system) all consumers attempt to purchase at the full price, provided the extra cost of quick response (c_Q) is not too high, as the following lemma summarizes.

Lemma 3. *The equilibrium price is greater in the quick response system than in the traditional system ($p_Q^* > p_T^*$) if and only if $p_T^* > c + c_Q$. Otherwise, $p_Q^* = p_T^*$.*

In sum, quick response provides value to the firm via two distinct effects:

1. The *sales effect*: All else being equal, the sales effect is the reduction in lost sales when quick response is implemented.

2. The *behavioral effect*: The behavioral effect is the increase in the selling price when quick response is implemented because consumers anticipate a lower probability of a sale (so they are willing to pay a higher initial price).[7]

One may think of the sales effect as the operational consequence of quick response (well studied in the literature, e.g., by Fisher and Raman 1996), whereas the latter effect is purely a consequence of strategic customer behavior. The fact that quick response generates value via two independent mechanisms is critical when we discuss the value of fast fashion in §7.

5.   Enhanced Design

In the enhanced design system, the production lead times are long but the firm invests in improved design efforts that result in greater value to consumers. Thus, we assume that enhanced design results in a marginal increase of $m \geq 0$ to consumer value, that is, consumers possess valuations equal to $v + m$ for products resulting from enhanced design efforts.[8] However, when operating with enhanced design capabilities, every unit produced incurs an additional cost $c_D \geq 0$. To facilitate our analysis, the clearance price s is assumed to be identical to the clearance price in the traditional

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[7] In Cachon and Swinney (2009), quick response provides value by influencing the firm's dynamic sale pricing decisions during the selling season; here, the sale price is exogenously fixed, and quick response provides value by influencing the firm's initial pricing decision at the start of the season.

[8] In our model, enhanced design results in greater consumer value, which the firm then exploits to raise the selling price. An alternative model might assume that the selling price is fixed (possibly for competitive reasons), but enhanced design results in a more popular product and hence greater market share or size. Such a model, particularly one incorporating competition, may prove to be a fruitful direction for future research.

and quick response systems.[9] The sequence of events is identical to that depicted in Figure 1.

Because of the similarity in the sequence of events, the analysis of the enhanced design system is comparable to that of the traditional system. Firm profit with enhanced design is

$$\pi_D(q, p) = (p - s)S(q) - (c + c_D - s)q,$$

and the equilibrium conditions in Definition 1 apply once more in the enhanced design system (with consumer valuations and costs appropriately modified). Hence, the equilibrium conditions with enhanced design are

1. $(q_D^*, p_D^*) = \arg\max_{q, p} \pi_D(q, p)$;
2. $v + m - p_D^* \geq \delta\phi(v + m - s)$;
3. $\phi = F(q_D^*)$.

The following lemma follows immediately from Lemma 1.

LEMMA 4. *In a enhanced design system, an equilibrium with nonzero production exists and is unique. In equilibrium, all consumers purchase early. The equilibrium full price is*

$$p_D^* = \frac{A(v + m) + \sqrt{[A(v + m)]^2 - 4B(v + m, c + c_D)}}{2}.$$

Note that p_D^* is increasing in m and c_D, and the behavior of p_D^* as a function of the other parameters is identical to the behavior of p_T^*. Hence, because the traditional system is equivalent to the enhanced design system with $m = c_D = 0$, it follows that $p_D^* > p_T^*$, which we formally state in the following lemma.

LEMMA 5. *The equilibrium price is greater in the enhanced design system than in the traditional system* $(p_D^* > p_T^*)$.

Although the price is higher with the enhanced design system, the equilibrium consumer action remains the same as the traditional system: all customers purchase at the full price rather than wait for the sale. Thus, the firm can exploit enhanced design capabilities to raise prices without increasing strategic waiting, which is clearly beneficial to the firm if the increase in costs (c_D) is not too high. A necessary condition for enhanced design to be profitable is $p_T^* < p_D^* - c_D$, which implies that the margin on each sale increases as a result of enhanced design. Note that this is not a sufficient condition for the profitability of enhanced design, as an increase in production costs also implies an increase in costs due to excess inventory.

The preceding lemmas demonstrate that enhanced design influences firm profit via three distinct effects.

1. The *valuation effect*: The valuation effect is the increase in price, holding all else constant (such as ϕ and δ), due to the increase in valuations (from v to $v + m$).

2. The *cost effect*: The cost effect is adding c_D to the marginal production cost, which decreases the product margin and increases the loss incurred on excess inventory, holding all else constant (such as q and p).

3. The *behavioral effect*: Because of the change in valuations and costs, the optimal inventory level changes, resulting in either a decrease or increase in the probability of a clearance sale (ϕ), which in turn increases or decreases the price consumers are willing to pay.

Similar to the quick response case, the first two mechanisms (the valuation and cost effects) exist even if customers are completely nonstrategic; the latter mechanism, on the other hand, exists only if customers exhibit strategic behavior. Unlike the quick response case, these effects need not be beneficial to the firm. In particular, the cost effect clearly decreases firm profit, and the behavioral effect may either increase or decrease firm profit (because the price may go up or down as a consequence of this effect).

6. Fast Fashion

The fast fashion system combines operating characteristics of the quick response and enhanced design systems. As a result, the firm is capable of both raising consumer values for the product and reducing supply–demand mismatch. The sequence of events in the fast fashion system is the same as that depicted in Figure 2. As in the enhanced design model, consumers earn an extra value of m per unit, and every unit incurs an additional cost of $c_D \geq 0$. As in the quick response system, the firm has the option of obtaining additional inventory close to the selling season after receiving perfect demand information, at an additional cost of $c_Q \geq 0$ per unit. Thus, the firm possesses a comparable cost structure to the alternative systems, and firm profit with fast fashion is

$$\pi_F(q, p) = (p - c - c_D)\mu - c_Q L(q) - (c + c_D - s)I(q).$$

The equilibrium conditions are again identical to those in Definition 1, adapted appropriately to consumer valuations resultings from fast fashion. Thus the three equilibrium conditions are

1. $(q_F^*, p_F^*) = \arg\max_{q, p} \pi_F(q, p)$;
2. $v + m - p_F^* \geq \delta\phi(v + m - s)$;
3. $\phi = F(q_F^*)$.

Because the sequence of events is similar in the quick response and the fast fashion systems, the equilibrium follows immediately from Lemma 2 by setting consumer valuations equal to $v + m$ and increasing the production cost on every unit (procured both before and after the forecast update) by c_D.

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[9] One might (justifiably) argue that the clearance price should be higher in a system with enhanced design. This turns out to significantly complicate the analytical price and profit comparisons in our model; hence, we numerically investigate this possibility in §8.2.

LEMMA 6. *In a fast fashion system, an equilibrium with nonzero production exists and is unique. In equilibrium, all consumers purchase early. The equilibrium full price is*

$$p_F^* = v + m - \delta \frac{c_Q}{c + c_D + c_Q - s}(v + m - s).$$

Using Lemma 6, we derive the following result:

LEMMA 7. *The equilibrium price is greater in the fast fashion system than in all of the other systems* ($p_F^* > \max(p_D^*, p_Q^*, p_T^*)$) *if* $p_D^* > c + c_D + c_Q$.

In other words, the firm can leverage a fast fashion system to raise the equilibrium selling price in multiple ways via the mechanisms generated by the component strategies of fast fashion: quick response allows the firm to raise the price via the behavioral effect, whereas enhanced design allows the firm to alter the selling price via both the valuation and behavioral price effects. The combination of these effects results in a fast fashion system yielding the greatest equilibrium price (provided, as in the quick response system, costs are not too high so as to make the second inventory procurement option unprofitable).

Although Lemma 7 demonstrates that fast fashion results in higher equilibrium selling prices, this does not necessarily imply that a fast fashion firm (such as Zara) will have greater prices than a firm using traditional production. Indeed, Zara famously has *lower* initial selling prices than many of its rivals. This apparent discrepancy is due to the fact that our analysis compares prices for different production systems *holding all else equal*; in particular, baseline product quality. In addition to being famous for low prices and fast fashion production, Zara is also known to use cheaper materials, resulting in less durable, lower-quality products (designed to "be worn 10 times," as Ghemawat and Nueno 2003 note). Hence, for Zara, v (base consumer value) and c (base production cost) are both likely to be lower than at a higher-quality competitor, such as a traditional department store, resulting in lower prices at Zara despite the implementation of fast fashion production.

7. The Interaction of Enhanced Design and Quick Response

In this section, we analyze the impact of combining enhanced design and quick response in a fast fashion system. Specifically, we seek to answer the following question: are enhanced design and quick response complements or substitutes? If they are complements, then investing in a fast fashion system results in a superadditive benefit: the incremental value of a fast fashion system (the change in profit over a traditional system) is more than the combined incremental value

of enhanced design and quick response employed in isolation, i.e.,

$$(\pi_F^* - \pi_T^*) \geq (\pi_Q^* - \pi_T^*) + (\pi_D^* - \pi_T^*).$$

Simplifying this expression, quick response and enhanced design are complements if and only if $\pi_F^* - \pi_Q^* \geq \pi_D^* - \pi_T^*$. This expression provides a nice way of thinking about complementarity, which we will employ for the remainder of this paper: the practices are complements if adding enhanced design to quick response to form a fast fashion system leads to a greater incremental increase in profit than adding enhanced design to a traditional system.

Our first result is that, in general, it is possible for quick response and enhanced design to be either complements or substitutes. To see this, we will examine a series of examples, each highlighting how a different effect of enhanced design or quick response can influence the interaction of these practices. Recall that quick response impacts profit via a sales effect (eliminating lost sales) and a behavioral effect (influencing consumer purchasing behavior, allowing for a greater selling price). Enhanced design impacts profit via a valuation effect (adding m to consumer valuations), a cost effect (adding c_D to marginal production cost), and a behavioral effect (altering consumer incentives to strategically wait for the sale).

EXAMPLE 1 (OPERATIONAL INTERACTION). In our first example, we eliminate the behavioral effects of both quick response and enhanced design by imposing $\delta = 0$, i.e., nonstrategic consumers. Moreover, we eliminate the cost effect of enhanced design by imposing $c_D = 0$, so all that remains is the valuation effect of enhanced design and the sales effect of quick response. These two remaining effects are always complements. This is because increasing consumer valuations and thus the selling price (adopting enhanced design) is more valuable to the firm if sales are higher (i.e., if the firm also employs quick response) and the marginal increase in price is earned on more units. To illustrate, consider the case when, in addition to $\delta = 0$ and $c_D = 0$, $s = 0$ and $c_Q = 0$. The optimal selling prices are $p_T^* = p_Q^* = v$ and $p_D^* = p_F^* = v + m$. The incremental change in expected profit from enhanced design is

$$\pi_D^* - \pi_T^* = (v + m)S(q_D^*) - cq_D^* - vS(q_T^*) + cq_T^*$$
$$\leq (v + m)S(q_D^*) - cq_D^* - vS(q_D^*) + cq_D^*$$
$$= mS(q_D^*) \leq m\mu = \pi_F^* - \pi_Q^*.$$

The inequality follows from the fact that, in the traditional system, profit evaluated at quantity q_D^* is less than profit evaluated at quantity q_T^*, by definition of the optimal quantity q_T^*. Thus, with fast fashion, the

additional margin from enhanced design is enjoyed on the mean demand, whereas with enhanced design (and no quick response abilities) the additional margin is only enjoyed on the expected sales (mean demand minus lost sales), which are by definition less than the mean demand. Consequently, enhanced design's valuation effect is more beneficial if the firm also possesses quick response, leading to a complementary relationship. We call this a case of *operational complementarity* because it exists even in the absence of strategic customer behavior.

This result can be generalized beyond this specific example, leading to the following theorem:

THEOREM 1. *If* $\delta = 0$ *and* $c_D \leq \min(m, ((c-s)/(c+c_Q-s))(v+m-c-c_Q))$, *quick response and enhanced design are complements.*

Theorem 1 provides a sufficient condition for complementarity when customers are nonstrategic. Examining the condition in the theorem, if $c_Q = 0$, the condition reduces to $c_D \leq m$, i.e., that enhanced design is profitable on a marginal basis.[10] Otherwise, the firm earns negative margin from enhanced design, and earning a negative margin on mean demand results in a greater reduction of firm profit than earning a negative margin on expected sales, leading to a substitution effect. Larger c_Q tightens the restriction on c_D to account for the impact of inventory overage costs in the fast fashion system (because, when $c_Q > 0$, there will be some supply–demand mismatch even in the fast fashion system), but the logic remains the same.

The next two examples reintroduce strategic consumer behavior ($\delta > 0$) and demonstrate how the behavioral interactions can lead either to complementarity or substitution. In both examples, demand is normally distributed with $\mu = 150$ and $\sigma = 75$, and $\delta = 0.9$, $v = 8$, $c = 2$, $s = 1.9$, $c_Q = 0$, and $m = 1$.

EXAMPLE 2 (BEHAVIORAL COMPLEMENTARITY). In this example, $c_D = 0$, eliminating the cost effect of enhanced design. In the traditional and enhanced design systems, equilibrium prices are $p_T^* = 3.44$ and $p_D^* = 3.65$. Expected profits in these systems are $\pi_T^* = 201$ and $\pi_D^* = 232$, and the incremental value of enhanced design is $\pi_D^* - \pi_T^* = 31$. In the quick response and fast fashion systems, equilibrium prices are $p_Q^* = 8$ and $p_F^* = 9$ (costless quick response means the firm produces all inventory after learning demand, allowing the firm to eliminate clearance sales and extract all consumer surplus), with

expected profits equal to $\pi_Q^* = (p_Q^* - c)\mu = 900$ and $\pi_F^* = (p_F^* - c - c_D)\mu = 1{,}050$. The incremental value of adding enhanced design to quick response to make a fast fashion system is $\pi_F^* - \pi_Q^* = 150$, and so in this example, quick response and enhanced design are complements.

The reason for this is that, in addition to the operational complementarity (see Example 1), quick response and enhanced design are complements along the behavioral dimension as well. This can be seen in the increase in the equilibrium price resulting from enhanced design. Adding enhanced design to a traditional system only results in a price increase of $p_D^* - p_T^* = 0.21$, whereas adding enhanced design to quick response to form a fast fashion system yields a price increase of $p_F^* - p_Q^* = 1$.

The change in the critical ratios (and hence, the probability of a clearance sale) is the key to understanding this example. Table 2 lists the critical ratios in each system. Notice that, given $c_Q = 0$, adding enhanced design to quick response does not change the critical ratio—it is 0 in either case. Enhanced design increases the price by m when it is added to a quick response system because quick response has already eliminated the incentive for customers to wait (there will be no leftover inventory, so there surely will not be a discount). Consequently, the firm can increase the price to capture the full increase in value of enhanced design.

Adding enhanced design to a traditional system generates a smaller increase in the price for two reasons. First, there remains some chance that a discount will occur (because the firm must purchase inventory up front), so the firm must temper its price increase to induce consumers to purchase at the full price. Second, enhanced design raises the critical ratio (because the price increases but there is no corresponding increase in cost, because $c_D = 0$) compared to the traditional system. As a result, the firm stocks more inventory and thus *increases* the chance that a discount will occur—consequently, the firm must temper the price increase even more to counteract this effect and induce consumers to buy at the full price. The behavioral effect of enhanced design thus has negative value to the firm in Example 2, and quick response and enhanced design are complements because the

Table 2   Equilibrium Overage Costs, Underage Costs, and Critical Ratios

	T	D	Q	F
Underage cost	$p_T^* - c$	$p_D^* - c - c_D$	c_Q	c_Q
Overage cost	$c - s$	$c + c_D - s$	$c - s$	$c + c_D - s$
Critical ratio	$\dfrac{p_T^* - c}{p_T^* - s}$	$\dfrac{p_D^* - c - c_D}{p_D^* - s}$	$\dfrac{c_Q}{c + c_Q - s}$	$\dfrac{c_Q}{c + c_Q + c_D - s}$

behavioral effect of quick response eliminates the (negative) behavioral effect of enhanced design.

However, a key feature of this example is that enhanced design has a low marginal cost, i.e., $c_D = 0$. The next example demonstrates that although enhanced design can increase profits even though it has a high marginal cost, its interaction with quick response can become one of substitutes.

EXAMPLE 3 (BEHAVIORAL SUBSTITUTION). In this example, we consider the extreme case when the marginal cost of enhanced design equals the increase in consumer value, $c_D = m = 1$. In the traditional and enhanced design systems, equilibrium prices are $p_T^* = 3.44$ and $p_D^* = 5.21$. Expected profits are $\pi_T^* = 201$ and $\pi_D^* = 241$; hence the incremental value of enhanced design is $\pi_D^* - \pi_T^* = 41$. In the quick response and fast fashion systems, equilibrium prices remain $p_Q^* = 8$ and $p_F^* = 9$, but expected profits are equal to $\pi_Q^* = (p_Q^* - c)\mu = 900$ and $\pi_F^* = (p_F^* - c - c_D)\mu = 900$. The incremental value of adding enhanced design to quick response to form a fast fashion system is thus $\pi_F^* - \pi_Q^* = 0$, clearly less than the value of adding enhanced design to a traditional system; hence, quick response and enhanced design are substitutes. Observe that in this example $p_D^* - p_T^* = 1.77 > 1 = p_F^* - p_Q^*$; that is, enhanced design results in a larger increase in the equilibrium price when used in isolation than when used in conjunction with quick response.

Returning to the critical ratios listed in Table 2, observe that, because $c_Q = 0$, adding enhanced design to quick response does not change the critical ratio. Consequently, the price increases from 8 to 9, just like in Example 2. But in Example 3, the firm does not benefit from that price increase because enhanced design is costly, $c_D = 1$, and by construction, sufficiently costly to eliminate all benefits from this price increase.

Given that the firm gains nothing from adding enhanced design to quick response, it would be tempting to conclude that the firm would also gain nothing (or maybe even lose) by adding enhanced design to a traditional system. But we see that this is not the case. The firm benefits from adding enhanced design to the traditional system because it actually lowers the firm's critical ratio. In fact, with these parameters, the critical ratio with enhanced design is even lower than in a traditional system. This means the firm stocks a lower quantity, which can lead to greater lost sales, but it also means that the probability of a clearance sale decreases. A lower chance of a clearance sale means strategic consumers are willing to purchase up front with a higher price. So the firm has fewer units to sell, but sells them at a higher price. The trade-off can work in the firm's favor, leading to higher profits.

In Example 3, the behavioral effect of enhanced design has positive value to the firm. Just like Example 2, because $c_Q = 0$, the behavioral effect of quick

response eliminates the behavioral effect of enhanced design, so there is no behavioral benefit to adding enhanced design to a quick response system. Quick response takes a positive effect of enhanced design and eliminates it. Thus, enhanced design and quick response are substitutes because enhanced design can generate a higher price increase without quick response than with quick response.

Generally speaking, the behavioral effect of quick response reduces the impact of the behavioral effect of enhanced design. The key to the net interaction of the two practices—whether they are complements or substitutes—lies in whether the behavioral effect of enhanced design has positive or negative value to the firm, which naturally depends on specific parameter values. We may, however, make a definitive statement about the interaction of enhanced design and quick response when $c_D = 0$:
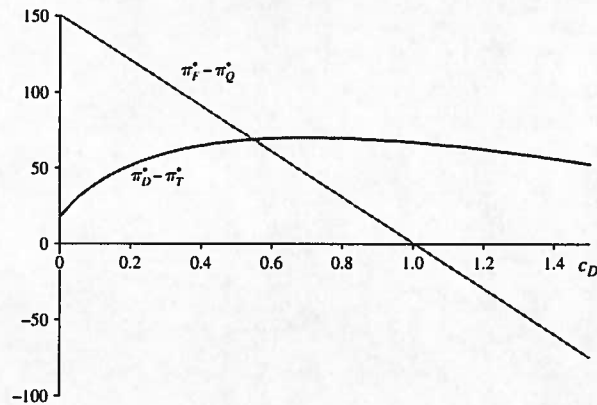
THEOREM 2. *If*

$$c_D = 0 \quad and \quad c_Q < s + \sqrt{(v + m - s)(c - s)} - c,$$

enhanced design and quick response are complements.

The second condition in Theorem 2 ensures that quick response is not so costly that it is unprofitable—the condition guarantees that units procured using quick response have a positive margin, otherwise the firm would not employ quick response. As a result, this is not a particularly restrictive condition. The first condition ($c_D = 0$) is more substantive, ensuring that enhanced design results in no additional marginal production cost, which, in accordance with Example 2 above, implies that enhanced design's behavioral effect is detrimental to the firm.

Based on this discussion, as one might expect, for a small c_D the behavioral effects of quick response and enhanced design are complements (because the behavioral effect of enhanced design has negative value), whereas for a large c_D they are substitutes (because the behavioral effect of enhanced design has positive value, and the behavioral effect of quick response reduces the impact of this effect). We have observed that this is indeed the case, and moreover the substitution effect typically grows stronger as c_D increases, a feature that is graphically depicted in Figure 3 for the same parameter combination used in the preceding examples. Although we do not analytically prove the behavior depicted in the figure, we have observed that substitution occurs above some threshold c_D in all numerical cases we have examined, an issue that we explore further in §8.

To summarize, the behavioral effects of the two strategies both serve to independently influence consumer purchasing incentives, and the behavioral effect of quick response always reduces the impact of the

Figure 3   The Incremental Value of Fast Fashion Over Quick Response $(\pi_F^* - \pi_Q^*)$ and the Incremental Value of Enhanced Design Over the Traditional System $(\pi_D^* - \pi_T^*)$, Plotted as a Function of the Cost of Enhanced Design, c_D

Table 3   Parameter Values Used In Numerical Experiments

Parameter	Values
Demand distribution	Normal
μ	150
σ	$\{75, 112.5, 150\}$
v	8
m	$\{1, 2, 3\}$
c	$\{2, 3, 4\}$
c_D	$\{0, 0.25c, 0.5c, 0.75c, c\}$
c_Q	$\{0, 0.25c, 0.5c, 0.75c, c\}$
s	$\{0.5c, 0.6c, 0.7c\}$
δ	$\{0, 0.2, 0.4, 0.6, 0.8, 1\}$

behavioral effect of enhanced design. Whether quick response and enhanced design are complements or substitutes hinges on whether this is beneficial to the firm. If the behavioral effect of enhanced design results in a decrease in firm profit (which happens if c_D is small), then the moderating presence of quick response's behavioral effect leads to complementarity. If, on the other hand, the behavioral effect of enhanced design leads to an increase in firm profit (which happens if c_D is large), then quick response's behavioral effect reduces the incremental impact of enhanced design along the behavioral dimension. If this substitution effect is sufficiently strong, it can overwhelm the complementary interaction along the operational dimension and lead to a net substitution effect.

8.   Numerical Study

The preceding analysis leads to several interesting questions. First, when the conditions Theorem 2 are violated (specifically the $c_D = 0$ condition), how pervasive is the complementarity result? Second, what is the magnitude of the complementarity effect? Third, how is the complementarity effect impacted by changes in the various parameter values (in particular, δ, the consumer discount factor)? And fourth, under what conditions fast fashion most valuable? Because the equilibrium expressions for prices, inventory levels, and profits are complex and difficult to decipher analytically, we employ an extensive numerical study in §8.1 to answer these questions. Section 8.2 presents a numerical analysis of an extension to our base mode: design-dependent clearance prices.

8.1.   The Value of Fast Fashion

The study consists of 12,150 total instances resulting from every possible combination of the values listed in Table 3. These parameters represent a wide range

of plausible values, chosen to represent realistic scenarios from the fashion apparel industry. The coefficient of variation of demand (σ/μ) equals 0.5, 0.75, or 1 (Hammond and Raman 1994 report similar values, e.g., less than one, in the context of skiwear). Maximum gross margins (i.e., $(v - c)/v$ in the standard design systems and $(v + m - c - c_D)/(v + m)$ in the enhanced design systems) range from 11% to 82% (actual gross margins depend on the equilibrium selling price and can even be negative in "unprofitable" enhanced design systems). These figures are in line with the reported gross margins from the annual filings of many fashion apparel firms.[11] Enhanced design and quick response each incur 0% to 100% cost premiums (thus, fast fashion incurs 0% to 200% cost premiums), and "hot" products generated with enhanced design generate between 12% and 37% more consumer value than safe products created without enhanced design. Although these parameters are naturally more difficult to match to industry data, we believe they are plausible given the costs of local production versus outsourced production and transportation (e.g., a fast fashion designed product can be anywhere from the same cost as a traditional product to triple the cost of a traditional product).

For each parameter combination, we calculated the equilibrium under all four systems and determined expected prices and profits. Even though the sufficient conditions for complementarity from Theorem 2 were not satisfied by most parameter combinations, the complementarity result held in the vast majority of cases: in 11,411 instances (93.9% of the sample), we observed that the value of a fast fashion system (the increase in profit over the traditional system) was greater than the combined value of quick response and enhanced design operating alone. Fast fashion was optimal (provided the greatest expected profit) in 9,046 cases (74.5%). In a large number of instances

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[11] A search on Google Finance for fashion retailer gross margins in annual reports shows ranges in the interval 38% for Nordstrom to 70%–80% for leather-goods makers like Coach and Piquadro.

(5,130, 42% of the sample), $c_D \geq m$, seemingly leading to unprofitable enhanced design practices. However, in 2,083 of those cases (41% of the cases with $c_D \geq m$) fast fashion was the optimal production system. We conclude that fast fashion can lead even seemingly unprofitable enhanced design practices to have positive value, precisely because the behavioral effect of enhanced design can result in a price increase greater than m.

Next, it is interesting to examine the cases in which complementarity does *not* hold. In 739 of 12,150 instances we examined, quick response and enhanced design are substitutes—that is, adding enhanced design to a quick response system yields less incremental value than adding enhanced design to a traditional system. Our discussion in the preceding section suggested that c_D needs to be large to generate a substitution effect—in the 739 cases of substitution we observed, the average value of c_D was $0.87c$ (compared to an average value of $0.5c$ over the entire sample), and 440 of the cases were of the highest possible c_D in our sample ($c_D = c$). At the same time, quick response must be very inexpensive to generate the substitution effect—the average value of c_Q in the substitution cases was $0.21c$, and 431 of 739 cases had $c_Q = 0$.

We conclude from this that to generate a substitution effect, enhanced design must result in substantial additional costs (approximately 87%–100% of the standard production cost), whereas quick response results in minimal additional costs (on the order of 0%–21%). This implies that although a substitution effect is certainly theoretically possible, the parameter values necessary to generate substitution seem unrealistic.

Given that complementarity is so pervasive, we next investigate its magnitude. To facilitate this investigation, we define a complementarity factor as follows:

$$\text{complementarity factor}$$
$$= \frac{(\pi_F^* - \pi_T^*) - (\pi_D^* - \pi_T^*) - (\pi_Q^* - \pi_T^*)}{\pi_T^*}.$$

The numerator is the absolute magnitude of complementarity, which we scale by profit in the traditional system (π_T^*) to make for a fair comparison across the diverse parameter combinations in our sample. Thus, the complementarity factor may be thought of as a fractional representation of the complementarity effect—negative values represent substitution, and larger positive values represent a stronger complementarity effect.

Figure 4 plots the average complementarity factor in our sample as a function of both the fractional cost of enhanced design (c_D/c) and the consumer discount factor (δ). As expected given our discussion in §7, the figure shows that the strength of the complementarity effect is decreasing in c_D. The figure also

Figure 4 Magnitude of Complementarity as a Function of the Fractional Cost of Enhanced Design (c_D/c) and the Consumer Discount Factor ($\delta \in \{0, 0.2, 0.4, 0.6, 0.8, 1\}$)
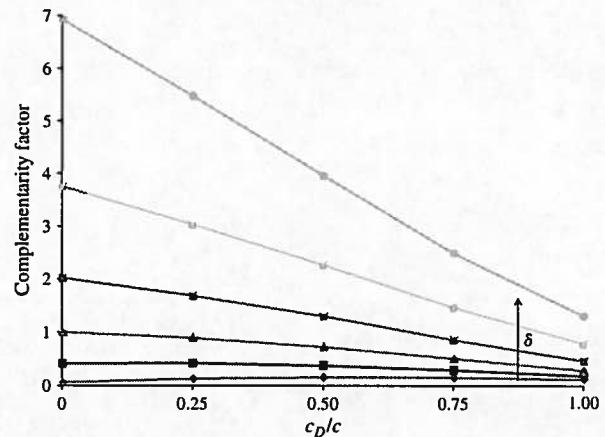
shows that the strength of the complementarity effect grows as δ increases; in other words, the more likely consumers are to delay a purchase (the higher δ), the more dramatic the complementarity effect. In the extreme case when $\delta = 1$ and $c_D = 0$, the average complementarity factor is almost 7, meaning that adding enhanced design to a quick response system generates roughly seven times the incremental profit that adding enhanced design to a traditional system generates. Consequently, the figure implies that quick response and enhanced design exhibit the strongest complementarity when enhanced design is inexpensive on a marginal basis and when consumers are likely to behave strategically.

Figure 5 plots the average complementarity factor as a function of the fractional cost of quick response (c_Q/c) and the consumer discount factor (δ). The figure demonstrates that the strength of the complementarity effect is smallest if $c_Q = 0$. As c_Q increases, the complementarity factor increases sharply then slowly decreases in a roughly concave shape. We conclude that the complementarity effect is strongest if c_Q is not too small.

Last, we consider when fast fashion is most valuable to the firm. Figure 6 plots the fraction of cases in our sample in which the fast fashion system yielded the highest profit, as a function of both the fractional cost of enhanced design (c_D/c) and the consumer discount factor (δ). The figure demonstrates three interesting features. First, fast fashion is more likely to be optimal if δ is larger—that is, fast fashion is most valuable when customers are very strategic. Second, fast fashion is less attractive to the firm as c_D increases, as one would expect; however, fast fashion is more sensitive to c_D if δ is small than if δ is large. This is intuitive, because the behavioral effect of enhanced design is more beneficial to

Figure 5   Magnitude of Complementarity as a Function of the Fractional Cost of Quick Response (c_Q/c) and the Consumer Discount Factor ($\delta \in \{0, 0.2, 0.4, 0.6, 0.8, 1\}$)
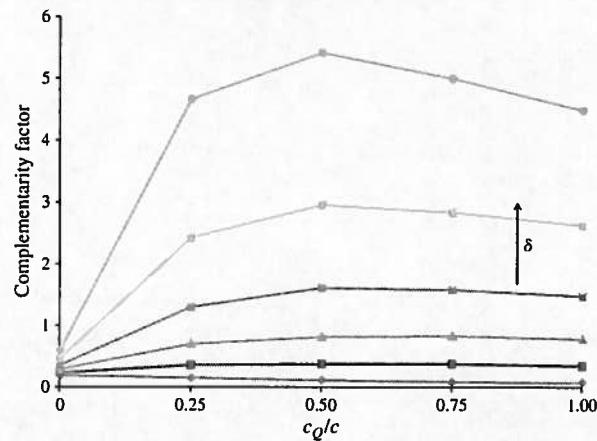
the firm if δ is large and if c_D is large. Third, the optimality of fast fashion corresponds perfectly with the complementarity of quick response and enhanced design—i.e., fast fashion is most likely to be optimal when quick response and enhanced design exhibits the strongest complementarity—demonstrating that the complementarities between the practices are key drivers of the value of fast fashion.

8.2. Design-Dependent Clearance Price
In the preceding analytical and numerical results, we assumed that the clearance or salvage price (s) was independent of the production system used by the firm. In particular, the enhanced design and fast fashion systems had no greater clearance price than the quick response and traditional systems, despite the purported enhancements to product design resulting
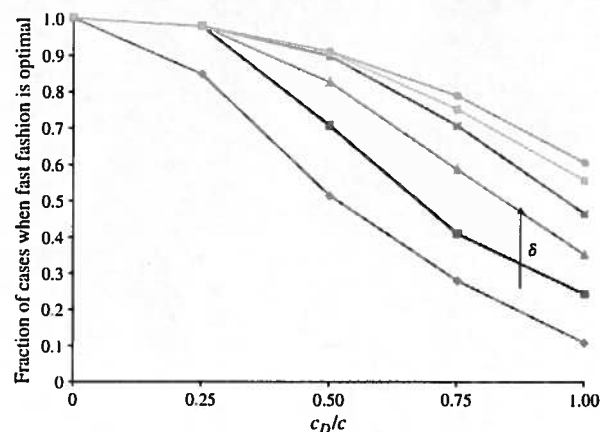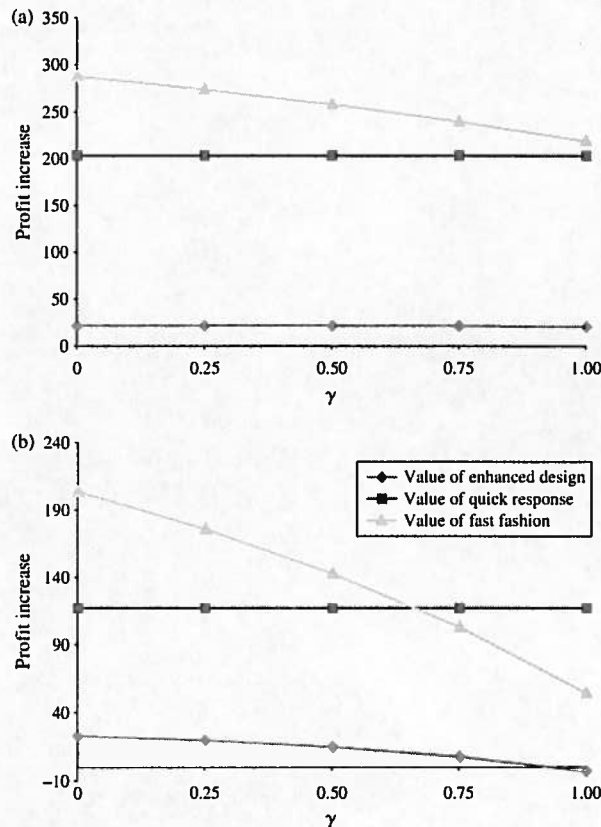
Figure 6   Fraction of Instances with Fast Fashion as the Optimal System as a Function of the Fractional Cost of Enhanced Design (c_D/c) and the Consumer Discount Factor ($\delta \in \{0, 0.2, 0.4, 0.6, 0.8, 1\}$)

in greater consumer value in the former two production modes. One might reasonably argue, though, that enhanced design results in changes to the product that yield an increase in the clearance price proportional to the increase in consumer value, m. In this section we consider this possibility, modeling the clearance price in the enhanced design and fast fashion systems as equal to $s + \gamma m$, where $\gamma \in [0, 1]$ represents the residual fraction of enhanced design's incremental value that carries into the clearance market.

This change complicates the analytical comparisons of the various systems significantly. The reason for this is that a higher clearance price, all else being equal, increases the firm's optimal inventory level, thereby increasing the probability of a clearance sale, and hence increasing consumer incentives to delay purchasing; this means the firm must reduce prices to induce consumers to buy early. At the same time, consumers must pay a higher clearance price, and so consumer utility (conditional on obtaining a unit) is reduced; this, in contrast to the preceding effect, means the firm can *raise* prices and still induce early purchasing. Which effect dominates is unclear, and consequently, the total effect of higher clearance prices on equilibrium full prices and inventory is not obvious. Moreover, even if higher clearance prices have an unambiguous effect on the equilibrium full price, the ultimate impact on profit is not clear; if, e.g., the increased availability effect dominates and full prices are decreasing in γ, the firm's salvage value is increasing in γ, meaning full price revenues are decreasing and clearance revenues are increasing in γ, with the net effect unclear. Hence, in this section, we resort to numerical analysis to study this issue.

We first discuss selected examples to understand the intuition behind the impact of γ. In these examples, demand is normal with $\mu = 150$ and $\sigma = 75$. In addition, $v = 10$, $m = 1$, $c = 3$, $c_D = 0.3$, $c_Q = 1.5$, and $\delta = 1$. Figure 7(a) illustrates the incremental value of each of the alternative production systems (i.e., the increase in profit over the traditional system) as a function of γ, the residual value parameter, when $s = 0.3$. Note that the value of quick response is independent of γ, because this system does not possess enhanced design features. Our first observation is that the value of enhanced design is not monotonic in γ (though the variation is slight); rather, it is roughly concave, peaking around $\gamma = 0.5$. Thus, the two counteracting forces we described above (an increase in γ leading to a simultaneous decrease in the selling price and increase in salvage values) dominate at different times: for small γ, the increase in clearance revenues dominates and leads to greater overall profit, whereas for large γ, the decrease in the equilibrium prices dominates and leads to lower profits.

Figure 7   An Example of the Incremental Value of the Various Production Systems as a Function of γ When $s = 0.3$ (a) and $s = 1.5$ (b)

this section; enhanced design has (relatively) minimal variation as a function of γ.

In Figure 7(a), fast fashion is always optimal, and the complementarity effect holds except at very high γ; in other words, unless a significant portion of the value increase m carries into the salvage period, complementarity holds, and fast fashion is optimal. For very high γ, complementarity no longer holds because of the severe effect of high clearance prices on the value of fast fashion. This is representative of the numerical examples we have explored, although we note that the "threshold γ" above which complementarity ceases to hold can vary substantially; in Figure 7(a), it is approximately 0.95, whereas in Figure 7(b), which is an identical example save for $s = 1.5$, the threshold γ is approximately 0.5.

To test this logic on a larger scale, we extended the full scale numerical study using the parameter combinations in Table 3 to allow for $\gamma > 0$. To ensure finite solutions in all possible combinations, we require $\gamma < 0.2$ (i.e., $\gamma > 0.2$ may result in negative overage costs in some instances, given our selected values of m, c, s, and c_D). We found that complementarity held in 93.1% of the sample with $\gamma = 0.05$, 92.2% of the sample with $\gamma = 0.1$, and 91.7% of the sample with $\gamma = 0.15$, compared to 93.9% of the sample with $\gamma = 0$. We conclude that our primary result, that quick response and enhanced design are typically complements, continues to hold with design-dependent salvage values if γ is not too large.

9.   Conclusion

With the success of fast fashion retailers, an increasing amount of attention—both academic and practical—has been paid to these innovative firms. In this paper, we present a modeling framework that allows us to capture and isolate the key aspects that define a fast fashion system: enhanced design efforts and quick response capabilities. By employing this approach, we analyze four potential operating systems—traditional systems (with standard design efforts and slow production), quick response systems, enhanced design systems, and fast fashion systems (with both enhanced design and quick response)—and characterize equilibrium inventory levels, prices, and consumer purchasing behavior in each case.

We focus much of our discussion on the issue of whether quick response and enhanced design are complements or substitutes. We find that although it is possible for the two practices to be substitutes, it is much more likely that they are complements. The reason is that there are multiple forces impacting sales and prices that determine complementarity. In the vast majority of our numerical cases (over 93%), the complementarity factors (significantly) outweigh

Next, observe that the value of fast fashion is decreasing[12] in γ, and at a faster rate than the value of enhanced design. This latter feature is characteristic of the examples we have examined. The greater impact of γ on the value of fast fashion appears to be rooted in the fact that the equilibrium in-stock probability is independent of the full price in the fast fashion system; hence, increasing γ unambiguously increases the in-stock probability in the fast fashion system. Greater in-stock probabilities in turn lead to lower equilibrium prices and profits. On the other hand, in the enhanced design system, the in-stock probability depends on the price as well as the salvage value; hence, greater salvage values leading to greater consumer incentive to delay may lead to lower prices, which in turn moderates the impact on the in-stock probability. The consequence of this result is that the value of fast fashion appears to be most sensitive to the assumptions on clearance price analyzed in

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[12] We note that the value of fast fashion need not be strictly decreasing in γ; as with enhanced design, a more concave shape is possible.

the substitution factors, leading enhanced design and quick response to be overall complements.

This result occurs despite the fact that, as we alluded to earlier, we have ignored a crucial aspect of how enhanced product design interacts with quick response: namely, that enhanced design may simply be more effective if production lead times are shorter. If, for example, the production lead time is six months, then no matter how much effort the firm places on product design, it still must finalize design well in advance of the selling season, meaning it may miss important trends and changes in consumer preferences. On the other hand, if the production lead time is one month, then design may be finalized much later, allowing the firm to pursue changing trends in a much more agile and responsive manner. Consequently, the potential value of enhanced design—all else being equal—can be greater if the firm has achieved quick response.

We find that, even controlling for the latter complementarity effect (assuming that it is zero), the two practices are almost always complements. Thus, the complementarity of these two strategies does *not*, in general, depend on the fact that production lead time reduction allows a firm to delay its design decisions. However, if we were to include this effect in concert with the other forces we have described, the complementarity of enhanced design and quick response would be even more dramatic, a fact which leads us to conclude that there is substantial value—operationally and behaviorally—from adopting a fast fashion approach.

The fact that enhanced design and quick response are complements—and that the magnitude of complementarity increases as customers become more strategic—helps to explain how even seemingly costly systems can be profitable. European fast fashion retailers such as Zara, H&M, and Benetton, for example, employ large staffs of in-house designers and even use costly local labor and expedited shipping methods when necessary. Although this seemingly puts these firms at a heavy cost disadvantage, they manage to reap additional benefits by minimizing strategic behavior, more so even than employing either production strategy by itself.

Naturally, when choosing whether to implement one of the strategies we describe, a firm must evaluate fixed costs in addition to the variable costs and operating profits that we analyze. However, the fact remains that even when fixed costs are accounted for, the value of the fast fashion system, relative to the alternative systems, generally increases as consumers become more patient (and hence more strategic in their purchasing behavior), a fact that justifies the use of sophisticated production systems capable of enhanced design and quick response in markets characterized by savvy consumer populations.

Crucially, the magnitude of complementarity between the base strategies of fast fashion systems is greatest if customers are very strategic and the marginal production cost impact of enhanced design is small, meaning we would expect to see most fast fashion implementations in precisely these conditions. This has important implications as the costs of enhanced design and quick response practices decrease because of advanced technologies such as three-dimensional printing (Vance 2010). This prediction may be empirically testable, which could present interesting opportunities for future research.

In addition, there are a number of other (nonoperational) reasons why a firm might adopt a fast fashion strategy, including competitive and marketing issues (e.g., fast fashion as a competitive distinction), market positioning (to high-end or fashion-conscious consumers), and political or social concerns (e.g., localized production as an act of social responsibility or public relations by the firm). All of these reasons, and doubtless many more, influence the value of fast fashion. However, as our model shows, an important consequence of fast fashion is its impact on consumer purchasing behavior and the operational efficiency of the firm. Although quick response and enhanced design practices are not suited to every industry or every product, in cases where the strategies are feasible and not prohibitively expensive, the reward for implementing such systems simultaneously can be significant, particularly when consumers are sophisticated.

Appendix. Proofs

PROOF OF LEMMA 1. As discussed above, the only viable equilibrium is one in which all consumers attempt to purchase at the full price. Hence, for this proof (and all remaining proofs) we restrict our attention to that case. The profit function in (1) is the familiar newsvendor formula yielding an optimal inventory level (given a particular price p) satisfying $F(q) = (p - c)/(p - s)$. Thus, this equilibrium is viable if consumers have incentive to purchase early, i.e., if

$$v - p \geq \delta\phi(v - s), \qquad (3)$$

if the firm chooses the optimal inventory level, $F(q_T^*) = (p - c)/(p - s)$, and if expectations of consumers are rational. Rationality of consumer expectations implies that ϕ is the actual probability that a consumer who unilaterally deviates from the equilibrium (by attempting to buy during

the clearance sale) obtains the product—in other words, the probability that a single consumer who buys late gets the product conditional on all other consumers (from the market represented by N) buying early. This occurs if and only if the firm has sufficient inventory, q_T^*, to cover the entire market, N. Hence, $\phi = \Pr(N \le q_T^*) = F(q_T^*)$. When choosing the price p, the firm maximizes its profit by selecting the highest price that satisfies (3), which implies the optimal pricing policy is to set a full price equal to $p_T^* = v - \delta\phi(v - s)$. Combining this expression with the $\phi = F(q_T^*)$ requirement yields $p_T^* = v - \delta((p_T^* - c)/(p_T^* - s))(v - s)$. Simplifying this expression yields

$$p_T^* = \frac{A(v) \pm \sqrt{A(v)^2 - 4B(v, c)}}{2}.$$

The lower candidate equilibrium sale price results in $p_T^* < c$, and hence is unsupportable; thus, a unique equilibrium exists which satisfies the conditions in the lemma. $\square$

PROOF OF LEMMA 2. $\pi_Q(q, p)$ is concave in q, and the unique optimal inventory level is given by $q_Q^* = F^{-1}(c_Q/(c + c_Q - s))$. Note that this quantity is *independent* of the selling price. Recall that consumers purchase early if

$$v - p \ge \delta\phi(v - s). \tag{4}$$

If the firm behaves optimally and if consumer expectations are rational, then $\phi = F(q_Q^*) = c_Q/(c + c_Q - s)$. Hence, the maximum price that induces consumers to purchase prior to the sale by making (4) hold with equality is given by (2). Alternatively, if $p < c + c_Q$, the firm will never use the option to procure additional inventory, meaning the profit function and equilibrium analysis reduce to that analyzed in Lemma 1. $\square$

PROOF OF LEMMA 3. By observing the expressions for the equilibrium prices, note that the price is higher in the Q system than the T system if and only if the probability that a customer obtains a unit at the sale price (ϕ) is lower in the Q system. This happens if $c_Q/(c + c_Q - s) < (p_T^* - c)/(p_T^* - s)$. Rearranging the terms, this reduces to $c_Q < p_T^* - c$. $\square$

PROOF OF LEMMA 4. The proof of Lemma 4 follows immediately from Lemma 1, by adjusting consumer valuations to be $v + m$ and marginal production cost to be $c + c_D$. $\square$

PROOF OF LEMMA 5. The proof follows immediately from the fact that p_D^* is increasing in c_D and m. $\square$

PROOF OF LEMMA 6. The proof follows immediately from Lemma 2, by adjusting consumer valuations to be $v + m$ and marginal production cost to be $c + c_D$. $\square$

PROOF OF LEMMA 7. Comparing the equilibrium prices from Lemmas 2 and 6, it is easy to see that $p_F^* > p_Q^*$. Comparing prices from Lemmas 4 and 6, observe that the price in the F system is greater than the price in the D system if and only if the equilibrium ϕ is lower in the F system, i.e., if $c_Q/(c + c_D + c_Q - s) < (p_D^* - c - c_D)/(p_D^* - s)$. Rearranging the terms, the inequality holds if

$$(p_D^* - c - c_D)(c + c_Q + c_D - s) - c_Q(p_D^* - s) > 0,$$

which, in turn, reduces to the condition $(c + c_D - s)(p_D^* - c - c_Q - c_D) > 0$. Because $c + c_D - s > 0$, a necessary and sufficient condition for the relationship to hold is $p_D^* - c - c_Q - c_D > 0$. The result that $p_F^* > p_T^*$ then follows from Lemma 5 if $p_D^* > c + c_D + c_Q$ holds. $\square$

PROOF OF THEOREM 1. If $\delta = 0$, $p_T^* = p_Q^* = v$ and $p_D^* = p_F^* = v + m$. Thus,

$$\pi_T^* = (v - c)\mu - (v - c)L(q_T^*) + (c - s)I(q_T^*),$$

$$\pi_Q^* = (v - c)\mu - c_Q L(q_Q^*) - (c - s)I(q_Q^*),$$

$$\pi_D^* = (v + m - c - c_D)\mu - (v + m - c - c_D)L(q_D^*)$$
$$\quad - (c + c_D - s)I(q_D^*),$$

$$\pi_F^* = (v + m - c - c_D)\mu - c_Q L(q_F^*) - (c + c_D - s)I(q_F^*).$$

The value of enhanced design over a traditional system is bounded above by

$$\pi_D^* - \pi_T^*$$
$$= (v + m - c - c_D)\mu - (v + m - c - c_D)L(q_D^*)$$
$$\quad - (c + c_D - s)I(q_D^*) - (v - c)\mu + (v - c)L(q_T^*) - (c - s)I(q_T^*)$$
$$\le (m - c_D)\mu - (m - c_D)L(q_D^*) - c_D I(q_D^*)$$
$$= (m - c_D)S(q_D^*) - c_D I(q_D^*).$$

The value of adding enhanced design to a quick response system is bounded below by

$$\pi_F^* - \pi_Q^* = (v + m - c - c_D)\mu - c_Q L(q_F^*) - (c + c_D - s)I(q_F^*)$$
$$\quad - (v - c)\mu + c_Q L(q_Q^*) + (c - s)I(q_Q^*)$$
$$\ge (m - c_D)\mu - c_D I(q_Q^*).$$

Sufficient conditions for complementarity are thus $m \ge c_D$ and $q_Q^* \le q_D^*$. The latter is equivalent to the condition

$$\frac{c_Q}{c + c_Q - s} \le \frac{v + m - c - c_D}{v + m - s}.$$

Rearranging this expression, we have

$$c_D \le \frac{c - s}{c + c_Q - s}(v + m - c - c_Q). \quad \square$$

PROOF OF THEOREM 2. Quick response and enhanced design are complements if $\pi_F^* - \pi_Q^* \ge \pi_D^* - \pi_T^*$. Let $S(x) = \mu - L(x)$ be the expected sales given an inventory level of x. Note that $S(x) \le \mu$ for any x. When $c_D = 0$, the equilibrium profit in each of the four systems is

$$\pi_T^* = (p_T^* - c)S(q_T^*) - (c - s)I(q_T^*),$$

$$\pi_Q^* = (p_Q^* - c)\mu - (c_Q)L(q_Q^*) - (c - s)I(q_Q^*),$$

$$\pi_D^* = (p_D^* - c)S(q_D^*) - (c - s)I(q_D^*),$$

$$\pi_F^* = (p_F^* - c)\mu - (c_Q)L(q_F^*) - (c - s)I(q_F^*).$$

Let $\pi_\Omega(q)$ be the profit in system $\Omega \in \{T, D, P, F\}$ at quantity level q. Observe that $\pi_F^* - \pi_Q^* = \pi_F(q_F^*) - \pi_Q(q_Q^*) \ge \pi_F(q_Q^*) - \pi_Q(q_Q^*)$, and hence

$$\pi_F^* - \pi_Q^* \ge (p_F^* - p_Q^*)\mu + c_Q(L(q_Q^*) - L(q_Q^*))$$
$$\quad + (c - s)I(q_Q^*) - (c - s)I(q_Q^*)$$
$$= (p_F^* - p_Q^*)\mu.$$

Similarly, $\pi_D^* - \pi_T^* = \pi_D(q_D^*) - \pi_T(q_T^*) \leq \pi_D(q_D^*) - \pi_T(q_D^*)$, which implies

$$\pi_D^* - \pi_T^* \leq (p_D^* - p_T^*)S(q_D^*) - (c-s)I(q_D^*) + (c-s)I(q_D^*)$$
$$= (p_D^* - p_T^*)S(q_D^*).$$

Because $S(x) \leq \mu$ for any x, it follows that $(p_D^* - p_T^*)\mu \geq (p_D^* - p_T^*)S(q_D^*) \geq \pi_D^* - \pi_T^*$. It follows that complementarity holds if $p_F^* - p_Q^* \geq p_D^* - p_T^*$, or equivalently if $p_F^* - p_D^* \geq p_Q^* - p_T^*$. Observe that when $m = 0$, $p_F^* - p_D^* = p_Q^* - p_T^*$ (that is, if both $c_D = 0$ and $m = 0$, fast fashion is equivalent to quick response and enhanced design is equivalent to the traditional system). Because p_Q^* and p_T^* are independent of m, to show $p_F^* - p_D^* \geq p_Q^* - p_T^*$ for all $m > 0$ it is sufficient to show $p_F^* - p_D^*$ is increasing in m. Substituting $c_D = 0$ into the equilibrium price equations from Lemmas 4 and 6, we have

$$p_D^* = \frac{(v+m)(1-\delta) + (1+\delta)s}{2}$$
$$+ \frac{\sqrt{((v+m)(1-\delta) + (1+\delta)s)^2 - 4(s(v+m) - \delta c(v+m-s))}}{2},$$

$$p_F^* = v + m - \delta\frac{c_Q}{c + c_Q - s}(v + m - s).$$

The difference between these expressions is

$$p_F^* - p_D^* = (v + m - s)\left(1 - \delta\frac{c_Q}{c + c_Q - s} - \frac{(1-\delta)}{2}\right.$$
$$\left. - \frac{1}{2}\sqrt{1 + \delta^2 - 2\delta\frac{v + m + s - 2c}{v + m - s}}\right).$$

Differentiating with respect to m,

$$\frac{d}{dm}(p_F^* - p_D^*)$$
$$= \left(1 - \delta\frac{c_Q}{c + c_Q - s} - \frac{(1-\delta)}{2}\right.$$
$$\left. - \frac{1}{2}\sqrt{1 + \delta^2 - 2\delta\frac{v + m + s - 2c}{v + m - s}}\right)$$
$$+ \frac{\delta(c-s)}{(v + m - s)\sqrt{1 + \delta^2 - 2\delta((v + m + s - 2c)/(v + m - s))}}.$$

The second term is clearly nonnegative; the first term is nonnegative if and only if $p_F^* \geq p_D^*$. From Lemma 5, this occurs if $c_Q < p_D^* - c$. Observing that p_D^* is decreasing in δ, and substituting $\delta = 1$ into the expression for p_D^*, we see that a sufficient condition for $c_Q < p_D^* - c$ is $c_Q < s + \sqrt{(v + m - s)(c - s)} - c$. This implies that if $c_D = 0$ and c_Q is sufficiently small, $p_F^* - p_D^*$ is increasing in m. The complementarity result ($\pi_F^* - \pi_Q^* \geq \pi_D^* - \pi_T^*$) follows. $\square$

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